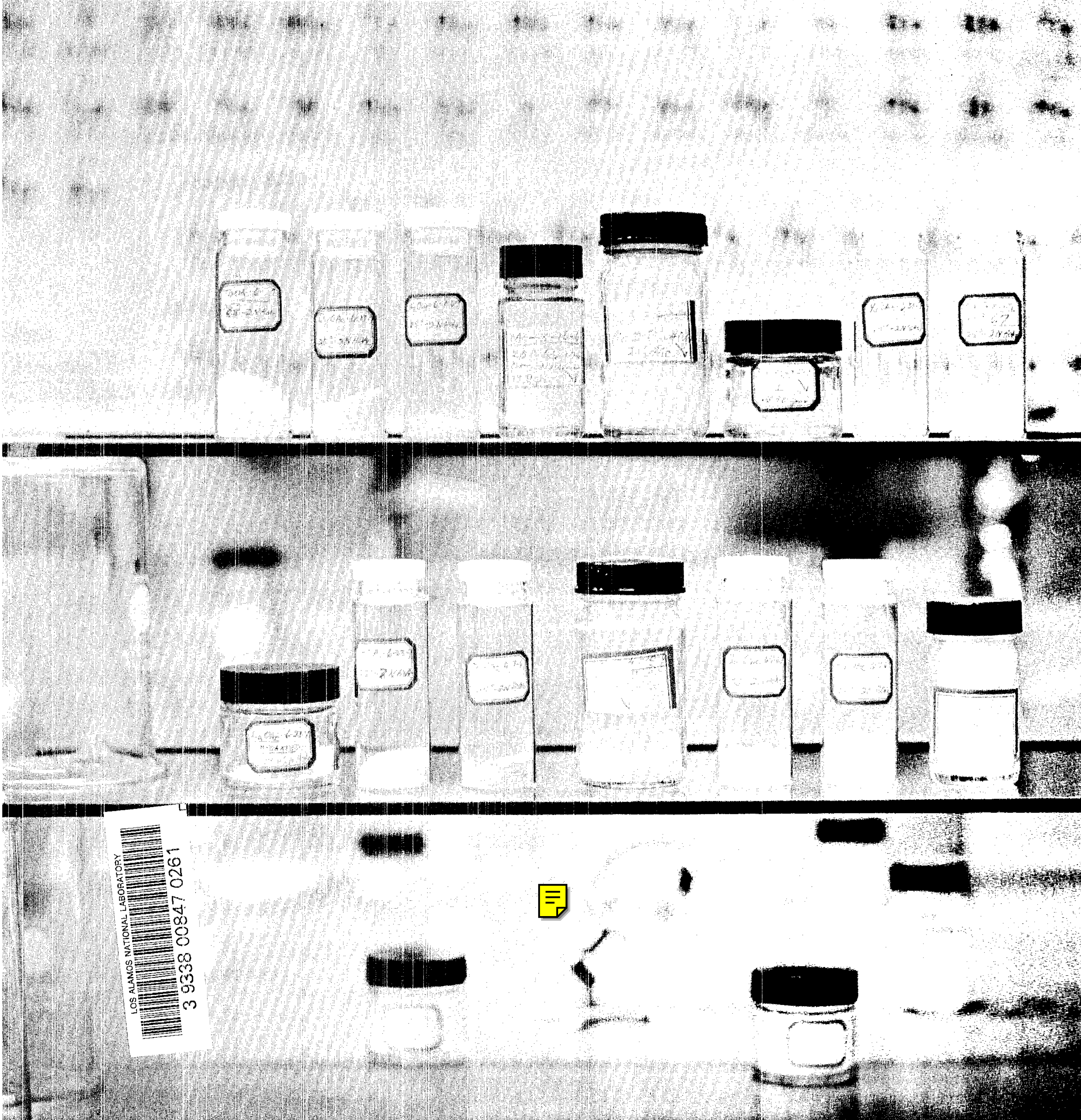
THE ATOM

Los Alamos Scientific Laboratory September



Volume 4 Number 9
September, 1967

THE ATOM

Published monthly by the University of California, Los Alamos Scientific Laboratory, Office of Public Relations, P. O. Box 1663, Los Alamos, New Mexico 87544. Second Class Postage Paid at Los Alamos.

CONTENTS:

Editor: Virginia S. Lees
Photography: Bill Jack Rodgers
Contributors: Members of the Public Relations staff

Office: D-413 Administration Building. Telephone: 7-6102. Printed by The University of New Mexico Printing Plant, Albuquerque.

Los Alamos Scientific Laboratory, an equal opportunity employer, is operated by the University of California for the United States Atomic Energy Commission.

COVER:
The "rare earths" have been, for many years, a puzzle to scientists. In his investigations of these elements, LASL's Earl Head has developed a new process for producing an important class of compounds—the carbonates—of these elements. Story begins on page 4.

George Cowan, J-11 group leader, chats with I. I. Rabi.

I. I. Rabi Speaks At Colloquium

Nobel laureate I. I. Rabi, one of the scientists instrumental in the development of the first atomic bombs in Los Alamos during the war and a consultant to the Los Alamos Scientific Laboratory since that time, spoke at a LASL colloquium last month.

Referring to the first days of the Los Alamos project, Dr. Rabi said, "It was a very bold venture, which reminded one of the saying, 'If we had ham, we could have ham and eggs—if we had eggs,' because none of the material from which a bomb might be made was available at the time. The ideas were wild and woolly, but they came to pass nevertheless."

The mission of Los Alamos, he pointed out, "is the achievement of national security through the development and perfection of atomic weapons—including the advancement of the science and technology on which the engineering of weapons is based. On the other hand, the hope of Los Alamos . . . is peace.

"The reason upright and decent people apply their minds and their ingenuity to the making of more efficient and ever more murderous atomic weapons is the belief that in this direction they can contribute to the ideal of peace. By strengthening national security, they believe they can deter any attack on the United States by a malevolent foreign power—and at the same time, and by the same means, act as a shield against aggression by rapacious dictators seeking conquest and influence."

Dr. Rabi said, "Los Alamos has a great tradition, and it had a noble origin."

Dr. Rabi was one of the scientists present for the Trinity test of the first atomic bomb. "I've seen other tests since, but of course it's the first time that counts," he said. "I got religion at that point, when I realized not only mentally and intellectually, but viscerally, what this meant or could mean to the world and what a problem and what an obligation it presented to the people who have been concerned in this, who understood it—but even more, who felt it: that we were face to face, perhaps for the first time, with something so vast, so powerful—brought about by our own technical scientific community—that it had laid on us a responsibility which morally we could not shed. (We scientists) had to think about it, and to do everything in our power to see that this was contained, that it was used properly, was properly understood by our fellow citizens, properly understood by our leaders and by our government. I have devoted a large part of my efforts since in this direction."

Dr. Rabi is a member of the general advisory committee of the Arms Control and Disarmament Agency, which he described as "a separate agency of the government whose continual job is to search for ways and means to control the arms race." He added, "This agency has a definite, specific job which is different from any other agency: it is trying to achieve, in some way or other, a reduction of the arms race. . . . I think in principle, it's the most important introduction of a new element in this dreadful problem which confronts us in this arms race and in the perfection of atomic weapons.

"Arms reduction is not a trivial matter. It is a very profound and difficult subject because it has repercussions throughout our economic and political life. Right now, we're engaged in the next step with the general idea of preventing a proliferation of atomic weapons throughout the world. The agency which is helping the President form this policy is this Arms Control and Disarmament Agency.

continued on page 32

short subjects

Allen C. Larson, CMF-5, is on professional research and teaching leave at Cambridge University, England, for one year beginning this month. During this time he will be working with the biological crystal structure group at the university's chemical laboratory under a senior research fellowship. Larson, who worked first for LASL as a summer graduate student from 1954 to 1956, joined LASL as a permanent employe in October, 1956. He received his B.S. degree in chemical technology from North Dakota Agricultural College, Fargo, and his M.S. and Ph.D. degrees in physical chemistry from Washington University, St. Louis, Mo. He spent the academic year 1957-'58 at the University of Southern California as a postdoctoral fellow.

R. Jay Fries, N-1, is working at the Euratom Research Laboratories in Ispra, Italy. Fries left Los Alamos late last month for the new assignment, where he will be conducting research in high temperature materials. With LASL since November, 1958, he received his B. S. degree in mineral preparation engineering from Pennsylvania State University and his M. Litt. and Ph. D. degrees in physical chemistry from the University of Pittsburgh. Fries is on professional research and teaching leave from LASL for the duration of the appointment. Fries' wife and three children accompanied him.

Don H. Byers, W-8 alternate group leader, has been appointed a charter member of the newly-authorized Research Advisory Committee for the U.S. Army Nuclear Defense Laboratory, Edgewood Arsenal, Md.

The purpose of the six member committee is to conduct an annual review of the Nuclear Defense Laboratory's scientific program and make recommendations concerning the quality of the research program, the competence of the scientific staff and the adequacy of research facilities.

Byers has been a staff member of the Los Alamos Scientific Laboratory since 1958. He attended the University of Wichita, receiving his A.B. in 1952. He received his M.A. and Ph.D. degrees from the University of Kansas in 1954 and 1958, respectively. He is a member of the American Physical Society.

Louis Rosen, MP division leader, was seriously injured in an automobile accident Aug. 20 near Truth or Consequences, N.M. Dr. Rosen suffered several fractures and severe cuts. He is at Bataan Memorial Methodist Hospital in Albuquerque. His wife, Mary, and their daughter-in-law, Stephanie, were also seriously injured.

A staff member at the Laboratory since 1944, Dr. Rosen has received numerous awards and honors, including the E. O. Lawrence Award in 1963 "for the development of new experimental techniques and their application to a better understanding of the nucleus as well as to the diagnosis of weapon behavior." He is a fellow of the American Physical Society and is listed in "Who's Who in America." Dr. Rosen received his B.A. and M.S. degrees from the University of Alabama and his Ph.D. from Pennsylvania State University.

Darragh Nagle, an associate MP division leader, will serve as acting division leader until Dr. Rosen's return to the Laboratory.

Henry T. Motz, associate P division leader, has been appointed to the European-American Nuclear Data Committee of the Atomic Energy Commission. At the same time, Motz accepted chairmanship of the AEC's Nuclear Cross Section Advisory Group. Motz, who received his B. S., M. S. and Ph. D. degrees in physics from Yale University, has been with LASL since October, 1956, and served as P-2 group leader from May, 1961, until July 1, 1965, when he assumed his present post.

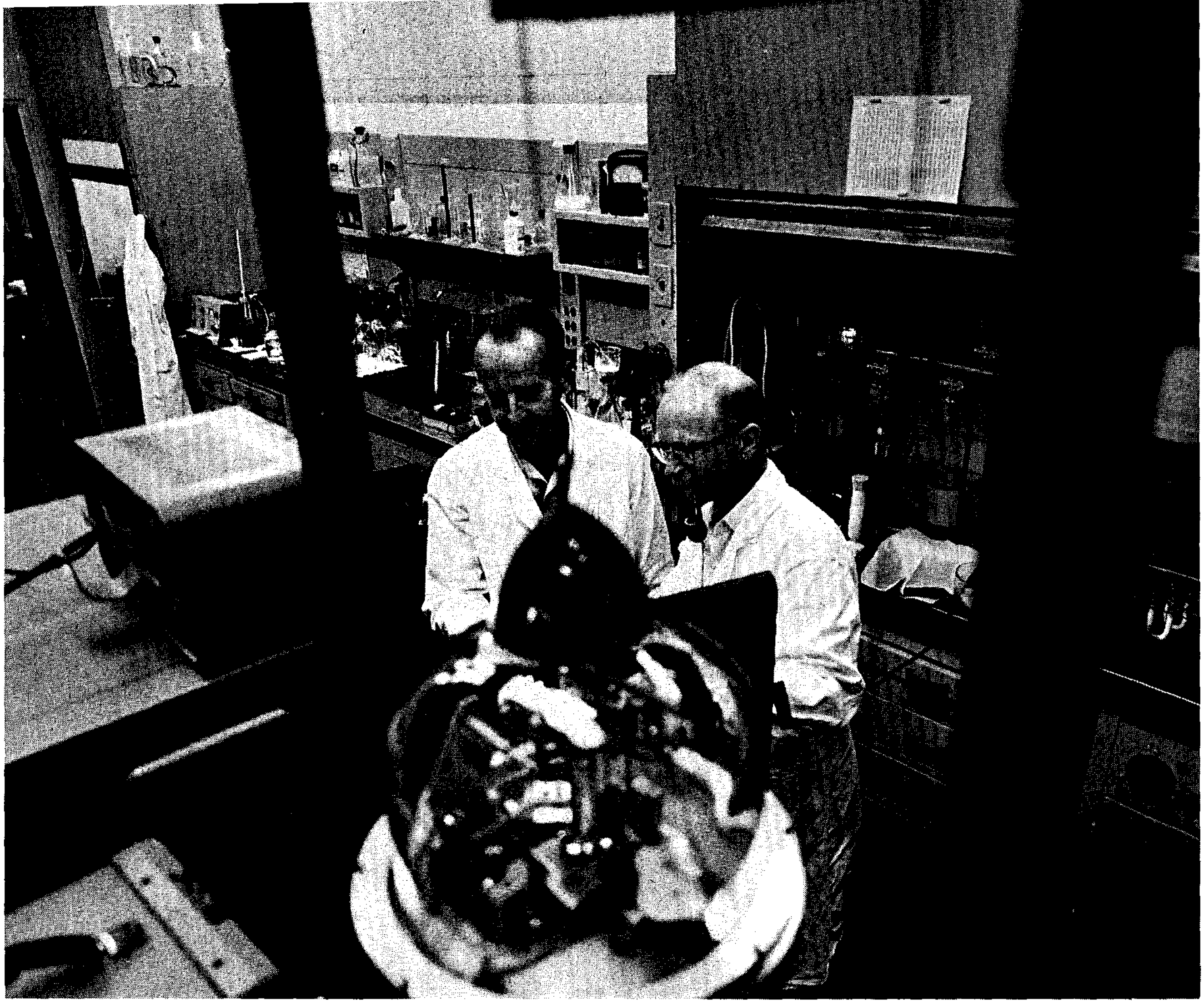
James M. Taub, CMB-6 group leader, has been appointed to the coatings committee of the National Research Council Materials Advisory Board. The committee was formed at the request of the National Aeronautics and Space Administration to review problems relating to superalloys, refractory metals and graphite and to establish future performance requirements of potential coating systems for these materials.

Taub, a Los Alamos Scientific Laboratory staff member since 1944, is recognized as a leader in the field of metallurgy. In 1963 he became the first metallurgist to receive the E. O. Lawrence Memorial Award.

The General Advisory Committee to the Atomic Energy Commission met for three days at the Los Alamos Scientific Laboratory early last month. Facing a work laden conference table at the opening session are from left: Manson Benedict, Massachusetts Institute of Technology, H. G. Vesper, vice president, Standard Oil Company of California; William Webster, chairman, New England Electric System; Edwin L. Goldwasser, University of Illinois physics department; GAC Scientific Officer Duane C. Sewell, Lawrence Radiation Laboratory; Chairman L. R. Hafstad, vice president, General Motors Corporation Research Laboratories; LASL Assistant Director Jane Hall; Stephen Lawroski, Argonne National Laboratory; Norman F. Ramsey, Harvard University department of physics; John C. Bugher, retired former director of the Puerto Rico Nuclear Center.

GAC Meets in Los Alamos

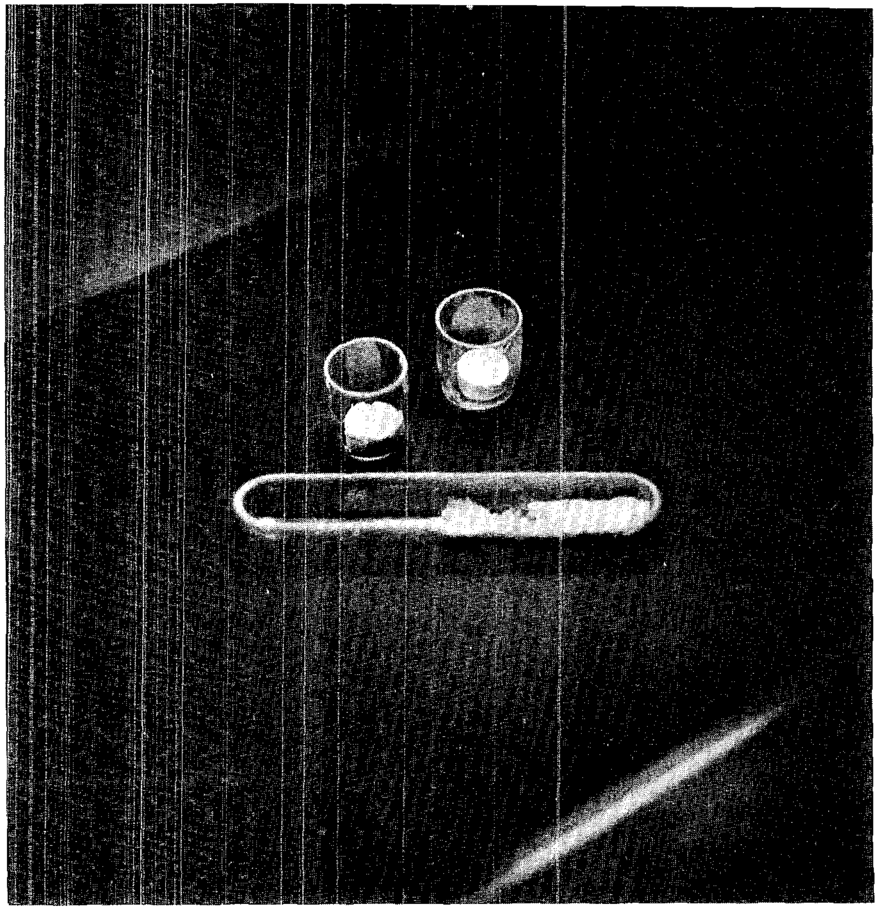
ABOVE: GAC members Vesper, Webster and Goldwasser discuss the capabilities of the Grover heat pipe with George Grover, N-5 group leader, right. BELOW: GAC member Jane Hall, LASL assistant director, welcomes Norman Ramsay, L. R. Rafstad and Edwin L. Goldwasser.



Earl Head, right, and Charles Holley check output from an automatic recording balance which weighs a sample of compound while it is being heated in a vacuum or in various gases. The balance automatically records on a strip chart any weight changes as the compound loses water of crystallization, CO_2 or other decomposition products.

LASL Studies of the Rare Earths

By Bob Masterson



Three yttrium-europium oxides produced by Earl Head glow while being illuminated with ultraviolet ("black") light. Such rare-earth phosphors have been used in recent years in color television picture tubes to give greatly improved color fidelity.

An investigation by Earl Head, CMF-2, into the basic chemistry of an unusual group of elements, the rare-earth metals or lanthanides, has led to a new process for producing the carbonates, an important class of compounds, of these elements.

This new process, which results in improved product yield, has been extended to a second related series of elements--the actinides—and used to produce carbonates of these elements, including a compound never before reported--thorium dicarbonate , or $Th(CO_3)_2$.

Head's investigations and the new process itself are shedding light on the chemistry of these two important groups of elements.

The rare earths, or lanthanides, consist of the 15 elements from lanthanum (atomic number 57) to lutetium (atomic number 71). Fourteen of the elements of this series were obtained originally as "earths" (as oxides were then called) from two rare minerals found in Sweden late in the 18th century.

The rare earths are practically identical chemically, and their separation and identification as individual elements was a difficult and laborious process requiring hundreds or even, in some cases, thousands of steps. For example, Auer von Welsbach separated neodymium and praseodymium in 1885 using a fractional crystallization process involving 85,000 crystallizations.

The last of the 14, finally isolated in 1907, still left a gap in the series, element 61, which was not filled until 1947 when a radioactive isotope of the missing element, named promethium, was discovered at Oak Ridge in the fission products of uranium.

The discovery of the first 14, however, resulted in a scientific puzzle of far-reaching implications. The trouble was that the rare earths didn't fit into the periodic table of the elements, which shows the periodic recurrence of similar chemical properties. In the periodic table, elements with similar chemical properties fall in the same vertical column. But all the rare earths, despite their increasing atomic numbers, are nearly identical chemically, so the baffled chemists of the early 1900's could only lump them all into one box below element 39, yttrium, and go on to hafnium, element 72, whose chemical properties made it fit very nicely under the element next to yttrium --that is, zirconium, element 40.

The answer to this puzzle finally came in the 1920's as a result of the Bohr theory, which added details to the picture of the electron-shell structure of the elements. It had previously been known that the electrons around a nucleus can have

continued on next page

1 **H** 1.0080																	2 **He** 4.003
3 **Li** 6.940	4 **Be** 9.013											5 **B** 10.82	6 **C** 12.011	7 **N** 14.008	8 **O** 16.000	9 **F** 19.00	10 **Ne** 20.183
11 **Na** 22.991	12 **Mg** 24.32											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.975	16 **S** 32.066	17 **Cl** 35.457	18 **Ar** 39.944
19 **K** 39.100	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.95	24 **Cr** 52.01	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.94	28 **Ni** 58.71	29 **Cu** 63.54	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.60	33 **As** 74.91	34 **Se** 78.96	35 **Br** 79.916	36 **Kr** 83.80
37 **Rb** 85.48	38 **Sr** 87.63	39 **Y** 88.92	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc**	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.4	47 **Ag** 107.880	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.70	51 **Sb** 121.76	52 **Te** 127.61	53 **I** 126.91	54 **Xe** 131.30
55 **Cs** 132.91	56 **Ba** 137.36	57-71 La Series	72 **Hf** 178.50	73 **Ta** 180.95	74 **W** 183.86	75 **Re** 186.22	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.09	79 **Au** 197.0	80 **Hg** 200.61	81 **Tl** 204.39	82 **Pb** 207.21	83 **Bi** 208.99	84 **Po**	85 **At**	86 **Rn**
87 **Fr**	88 **Ra** 226.03	89-103 Ac Series	(104)	(105)	(106)	(107)	(108)										

Lanthanide Series	57 **La** 138.92	58 **Ce** 140.13	59 **Pr** 140.92	60 **Nd** 144.27	61 **Pm**	62 **Sm** 150.35	63 **Eu** 152.0	64 **Gd** 157.26	65 **Tb** 158.93	66 **Dy** 162.51	67 **Ho** 164.94	68 **Er** 167.27	69 **Tm** 168.94	70 **Yb** 173.04	71 **Lu** 174.99
Actinide Series	89 **Ac** 227.04	90 **Th** 232.05	91 **Pa** 231.05	92 **U** 238.04	93 **Np** 237	94 **Pu** [242]	95 **Am** [243]	96 **Cm** [247]	97 **Bk** [247]	98 **Cf** [249]	99 **Es** [254]	100 **Fm** [253]	101 **Md** [256]	102	103 **Lw**

The "periodic table"—so called because it shows the periodic recurrence of similar chemical properties—was proposed by the Russian chemist Dmitri Mendeleev, in whose honor element 101 was named, in 1869 before the existence of electrons was known. In the table, the "families" of elements with similar chemical and physical properties are arranged into vertical columns. Later, with the discovery of the electron and the development of the Bohr theory of the atom, it was shown that these families of elements had similar properties because they had the same electron structure in their outer electron shells. The 15 lanthanide elements, because of their unusual electron structure, are almost chemically identical and therefore are all similar to scandium and yttrium and are all lumped into one box in the table. Their electron structure is unusual in that they all have the same numbers of electrons in their two outer electron shells and differ only in the number of electrons in the third shell from the outside. The same is true of the 15 actinide elements who also share one box in the periodic table.

Rare Earths . . .

continued from preceding page

only certain allowed energies and are located at certain energy levels. These levels, or electron shells, each have a particular capacity for electrons which can be explained on the basis of the nature of electrons and their interactions with each other. It was also known that the chemical nature of an atom is largely determined by the number of electrons in the outer shells.

Thus, the element astatine, with 85 electrons, is chemically very similar to fluorine, which has nine electrons, because they both have seven electrons in their outer shell, which lacks only one electron for completion. The inert gases, such as helium, neon and argon, all have a completed outer shell of eight electrons, and therefore they all very rarely take part in chemical reactions.

The key to the riddle of the rare earths, or lanthanides, was the discovery that in the more complex atoms with several electron shells, it is possible for outer shells to contain electrons even though one or more inner shells are not complete. In the case of the lanthanides it turns out that they all have the same number of electrons in their two outermost shells—and therefore have almost identical chemical properties. In going from lanthanum to lutetium, it is the shell third from the outside that is being filled with electrons.

However, with hafnium (element 72)—the element following lutetium—the electron must be added to an outer shell, and the hafnium atom therefore has properties different from those of the lanthanides.

This new understanding of why the lanthanides are so similar chemically was no help, however, to chemists trying to devise a cheap way of separating them, and in spite of the development of a few uses for small amounts of rare-earth compounds—for example, in incandescent gas mantles, in coloring agents for ceramics and glasses and in lighter flints and arc carbon cores—purified rare earths remained mostly laboratory curiosities until 1942 when the uranium fission

Finley Ellinger, CMF-5, carries an x-ray diffraction camera into the darkroom in his laboratory. X rays scattered from a crystal sample in the center of the camera are recorded on photographic film. The x-ray patterns from two samples can be compared to show whether they have identical crystal structure. CMF-5 is set up to make x-ray analyses of plutonium samples as part of the group's research in plutonium metallurgy. It is easy to do rare-earth samples because of similarity between rare earths and plutonium.

chain reaction was achieved. At this point, rare-earth chemistry became an urgent matter, because radioactive isotopes of some of these elements are among the main products of fission, and in the atomic bomb project it was necessary to separate and identify them quickly.

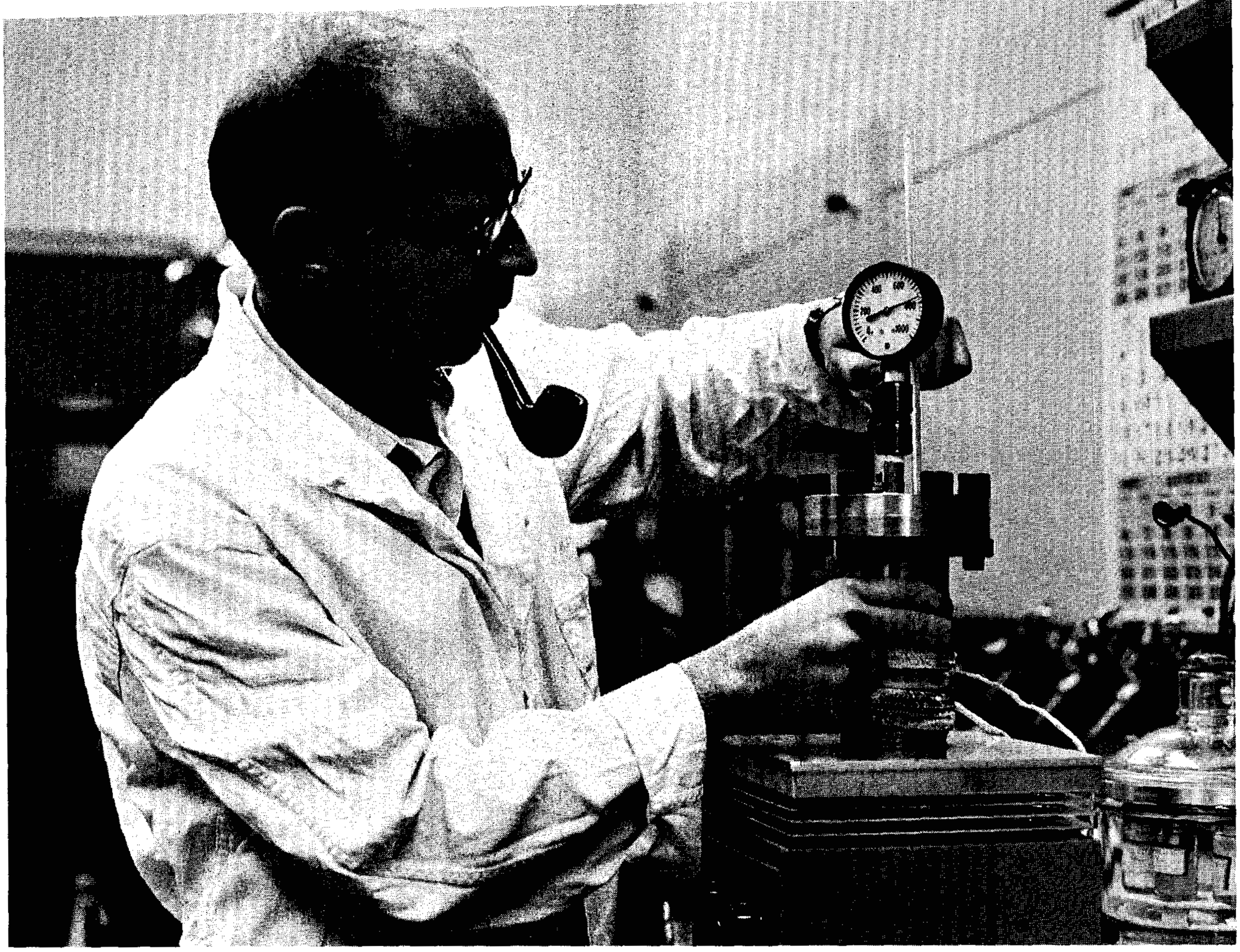
This problem was solved by F. H. Spedding and his coworkers at the Ames Laboratory by the application of ion-exchange techniques. A mixture of various rare earth compounds is passed through a long column containing a particular resin powder which adsorbs the rare earths onto its surface. The individual rare-earth elements differ in their strength of adhesion to the resin and are therefore separated into a series of bands. These bands of different elements can then be recovered from the column separately by use of the proper solvents.

Thanks to ion-exchange separation, purified rare-earth elements can now be prepared by the pound or even by the ton, and even though they are still far from cheap (current prices for the rare-earth metals range from $75 per pound for lanthanum and cerium to $8,000 per pound for lutetium), they are being studied increasingly and are consequently finding more and more commercial and industrial uses.

Examples of recent developments include the use of europium compounds in the red-emitting phosphors in color television tubes, resulting in far brighter and more realistic color television images; the use of rare-earth phosphors in fluorescent lamps; the commercial development of lasers using neodymium; construction of a permanent magnet, composed of one part yttrium and five parts cobalt, that exhibits three times the magnetic strength of the best magnets previously known; and the use of dysprosium and europium, which have great ability to absorb neutrons, in the control rods of large nuclear reactors.

In addition to these concrete applications, the new knowledge con-

continued on next page



Earl Head adjusts the CO_2 pressure in the special stainless-steel vessel he designed for producing rare-earth carbonates. A heating cable is wrapped around the base of the vessel, which rests on a magnetic stirrer. A thermometer inserted into a well measures the temperature inside the vessel.

Rare Earths . . .

continued from preceding page

cerning the lanthanides provided a key to the chemistry of the elements at the end of the periodic table, including the man-made ones. The first of the heavy elements in question, actinium (element 89), has an electron shell structure analogous to that of lanthanum, the first member of the lanthanide series. Actinium and the rest of the then known elements—thorium, protactinium and uranium—were not studied much before 1940, and what little was known about their chemistry suggested that they fit into the periodic table in the ordinary way.

But, when studies were made of neptunium (element 93) and plutonium (element 94)—produced in 1940 by bombarding uranium with neutrons—it was found that their chemistry strongly resembles that of uranium. Further studies of the elements from actinium through the two new man-made transuranium elements, neptunium and plutonium, revealed many similarities to the lanthanides. This prompted Glenn Seaborg to propose that the heavy elements were following the rare-earth pattern and filling an inner electron shell.

The subsequent production and investigation of the additional trans-uranium elements through element 103, lawrencium, have borne out this view, and the 15 heavier "rare-earth metals" (elements 89 to 103) are referred to as the actinide series. With lawrencium (103) the inner electron shell is filled, and element 104, as yet unproduced, is expected to have properties like hafnium, the element following the lanthanide series.

Since the actinide elements include the fissionable isotopes of uranium and plutonium, which are the basis for the nuclear weapons and nuclear reactor programs, and americium and curium (elements 95 and 96) whose radioactive isotopes serve as radiation and heat sources, the actinides, like the lanthanides, have large economic importance in addition to their great scientific significance.

Earl Head and Charles Holley, CMF-2 group leader, who worked with Head during the early stages of this project, first began investigating the carbonates of the lanthanides several years ago because these are, in general, a good starting point for producing other lanthanide compounds, and it was hoped they could be developed as a source of pure oxides capable of being dissolved in dilute acids at room temperatures for use in a program of study of the thermodynamic properties of the lanthanides.

They later found that there was much to be learned of interest and practical importance about preparing the lanthanide carbonates and determining the properties of this important series of rare-earth compounds. Very little was known about these compounds since they had pretty much been neglected, in part because nobody had been able to make all of them in their pure forms.

Earlier methods used to prepare carbonates of the lanthanide elements were unsatisfactory because they either produced compounds contaminated by the metal reactants, such as sodium carbonate, or produced compounds deficient in CO_2 for the rare earths above neodymium.

Head and Holley found that all of the rare-earth carbonates could be produced by carrying out the thermal decomposition of the trichloroacetate (CCl_3COO) salts in aqueous solution. When this decomposition was done at atmospheric pressure, the resulting products were deficient in carbonate ion.

Following a suggestion by Tom Newton of CMF-2 that the deficiency was caused by the low atmospheric pressure in Los Alamos, due to its 7300-foot elevation, the reactions were run in a carbon dioxide (CO_2) atmosphere at pressures of

continued on next page

The Actinides

ATOMIC NO.	NAME	SYMBOL
89	Actinium	Ac
90	Thorium	Th
91	Protactinium	Pa
92	Uranium	U
93	Neptunium	Np
94	Plutonium	Pu
95	Americium	Am
96	Curium	Cm
97	Berkelium	Bk
98	Californium	Cf
99	Einsteinium	Es
100	Fermium	Fm
101	Mendelevium	Md
102	Nobelium	No
103	Lawrencium	Lw

The Lanthanides

ATOMIC NO.	NAME	SYMBOL
57	Lanthanum	La
58	Cerium	Ce
59	Praseodymium	Pr
60	Neodymium	Nd
61	Promethium	Pm
62	Samarium	Sm
63	Europium	Eu
64	Gadolinium	Gd
65	Terbium	Tb
66	Dysprosium	Dy
67	Holmium	Ho
68	Erbium	Er
69	Thulium	Tm
70	Ytterbium	Yb
71	Lutetium	Lu

Finley Ellinger of the CMF-5 plutonium metallurgy group examines the x-ray diffraction pattern, as recorded on the strip of film, from a sample of one of Earl Head's rare-earth compounds.

Rare Earths . . .

continued from preceding page

100 to 900 pounds per square inch, resulting in a much improved product.

By further modifying the reaction conditions, Head found that the desired compounds could be prepared using the carbon dioxide as the source of carbonate ion with the lanthanide element being supplied as the hydrated acetate (CH_3COO)—that is, a salt whose crystal form includes water molecules. He later found that by using the anhydrous (containing no water) acetate salt, the yields were increased. This result was surprising, since both the hydrated and anhydrous salts were dissolved in water before the preparation of the carbonates—and therefore should be identical.

This reaction is carried out in a special high-pressure, stainless steel reaction vessel about three inches in diameter and eight inches tall.

Using this new process, Head has prepared all of the lanthanide carbonates and is studying the various factors which affect the form—such as crystal structure and number of water molecules incorporated in the compounds—and the purity and amount of the product.

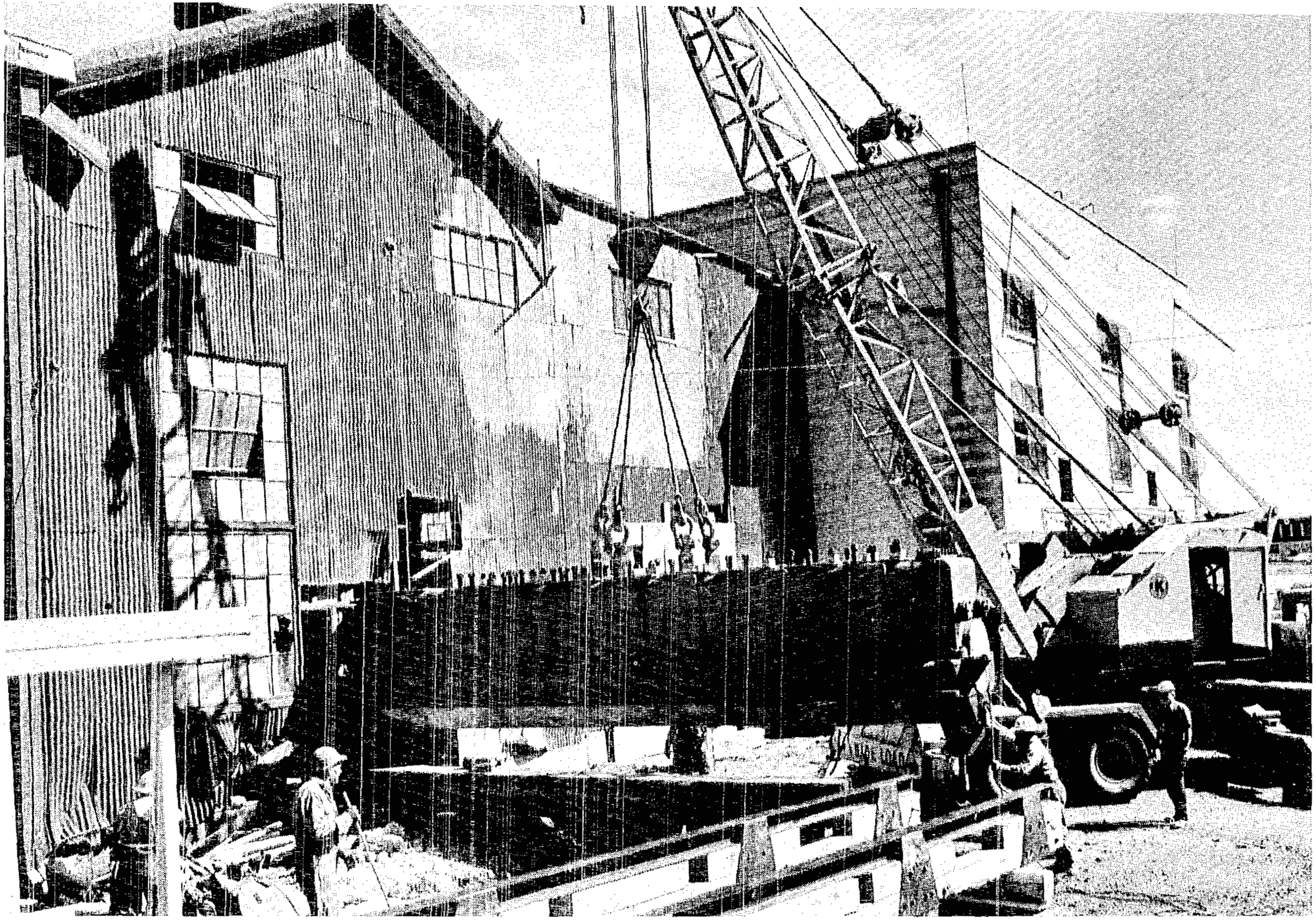
The effect of these factors—temperature, CO_2 pressure, ph(hydrogen ion concentration) of the solution, length of reaction run, acetate concentration and history of the acetate (how it was prepared and handled)—varies with the particular lanthanide carbonate being prepared, and these variations in turn help to reveal the complex and still largely unknown chemistry of the lanthanides.

Head identifies the chemical composition and measures the water content of his products himself, but the crystal structure must be checked by x-ray diffraction analysis which is done by Finley Ellinger of CMF-5. The pattern in which x rays are diffracted, or scattered, by a crystal is determined by the detailed atomic structure of the crystal, and therefore by comparing the x ray diffraction pattern of two samples, it can be determined whether they have the same crystal structure as well as the same chemical composition.

The work has been broadened to include preparation of two actinide carbonates—uranyl carbonate ($UO_2 CO_3$) and the previously-mentioned thorium dicarbonate [$Th(CO_3)_2$]. All earlier attempts to make the latter compound using other methods had failed.

The thorium dicarbonate production is significant because this is a convenient form in which to irradiate nonfissionable thorium 232 with neutrons in a reactor to produce fissionable uranium 233 by a process patented by Seaborg and Raymond W. Stoughton. In this manner it is possible to convert abundant thorium into the valuable reactor fuel, uranium 233, and an efficient process for producing thorium carbonates might be important to such a breeder reactor program.

Thus, as is so often the case with basic research, an investigation that started in one direction—the production of special lanthanide oxides—has evolved into related studies that have resulted not only in an increase in the fundamental scientific knowledge of the chemistry of an important group of elements, but has also produced practical results with potential industrial applications.



Diesel units are so large they had to be removed through holes made in the sides of the building.

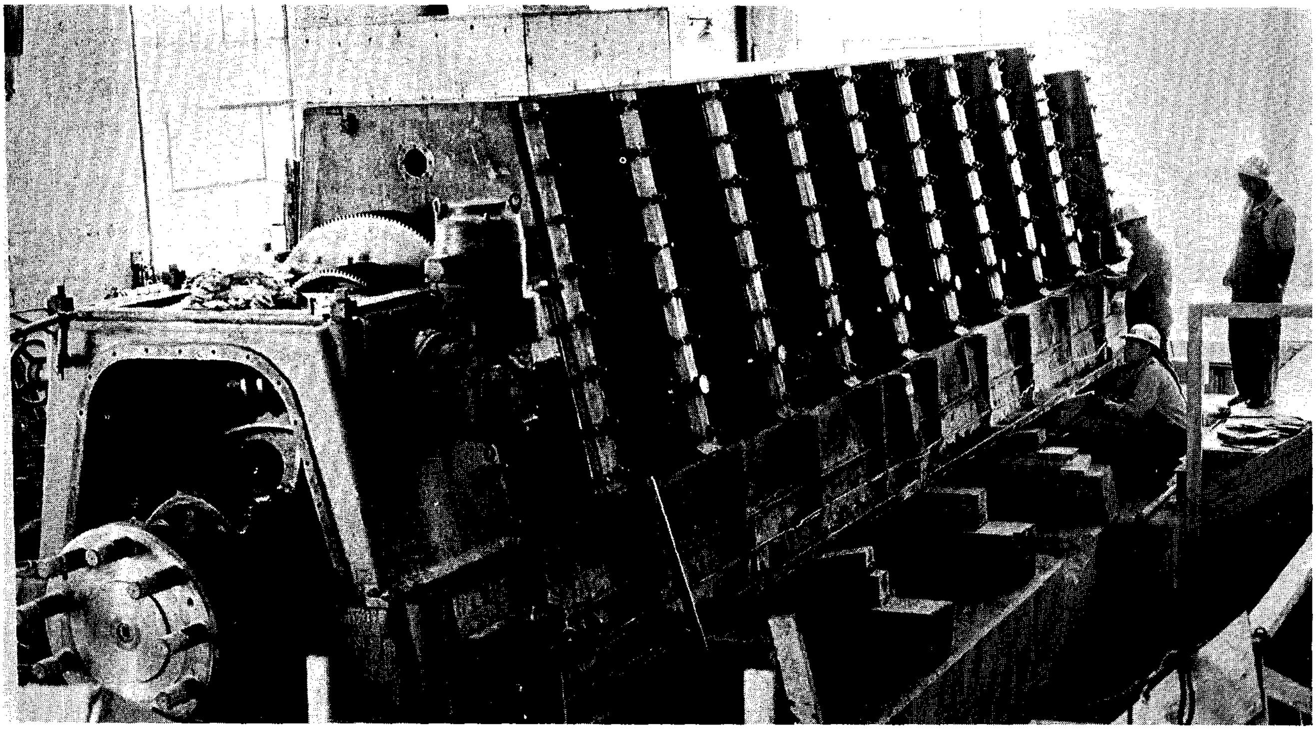
Diesel Plant Dismantled

Six big diesel generator units that once supplied electric power to Los Alamos are on their way to far-flung places to serve Navy communications stations. The six, along with three other units which were sold as salvage, were in the old generating plant on Trinity Drive. The equipment has been removed, and the building will soon be dismantled, as it is no longer needed for the Los Alamos power supply.

Two of the generators are destined for the Panama Canal Zone, two will go to Kodiak Island, Alaska, and two will go to Morocco.

One of the three small units which have been sold as scrap was brought to Los Alamos in 1943 after being used for nearly 20 years in mining operations in Mexico and New Mexico. During the war, these three units supplied the

continued on next page



Zia Company workmen Ben Lujan, Ben B. Valdez and rigger foreman Reudolph White prepare one of the big diesel units for removal from the building. The diesel engines of the two largest units each weighed more than 300,000 pounds.

Units were taken apart and crated for shipment to Navy installations in Morocco, Alaska and the Canal Zone, where they will be used at communications stations.

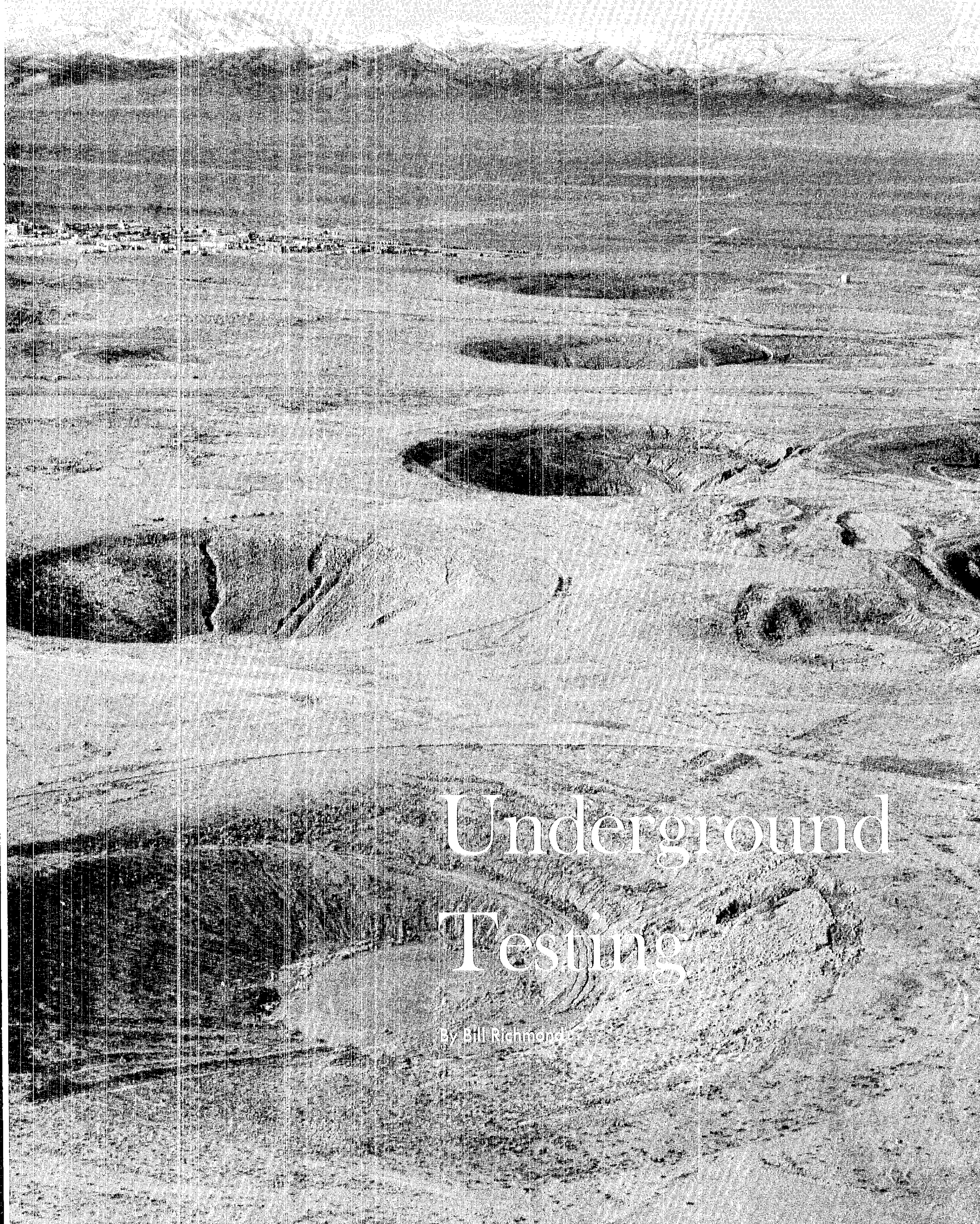
Diesel Plant . . .

continued from preceding page

power for the entire community—which was then clustered in the Ashley Pond-Community Center area.

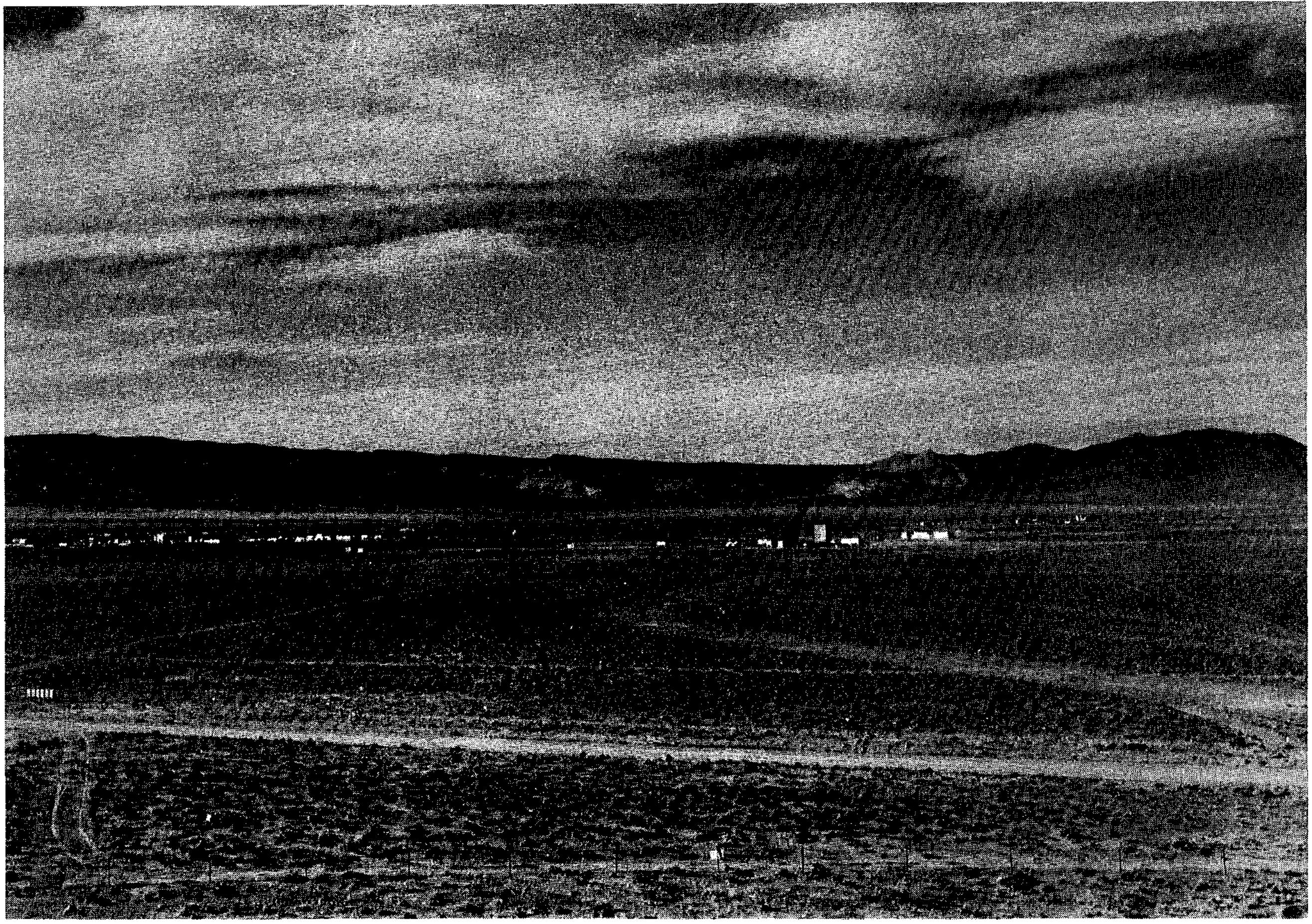
After it had been decided the Laboratory would remain in Los Alamos after the war, the steam plant on south Diamond Drive was built. Since then, two 115,000-volt lines from Public Service Company of New Mexico have been brought into Los Alamos. For a time, the old diesel plant was used during peak load periods, but since the steam plant was built and larger supply lines have been installed, it is no longer needed.

The site of the old diesel plant will be turned over to Los Alamos County. According to Paul Noland, county administrator, "very preliminary" negotiations have taken place between county and Mountain States Telephone Co. officials for possible use of a part of the diesel plant site.



Underground Testing

By Bill Richmond



Vastness of Yucca Flats is ideal for underground testing. Crane on right lowers pipe downhole. At left is a support area.

THE VAST STRETCHES of the southern Nevada desert northwest of Las Vegas rolled with a man-made earth tremor on the average of once a week last year.

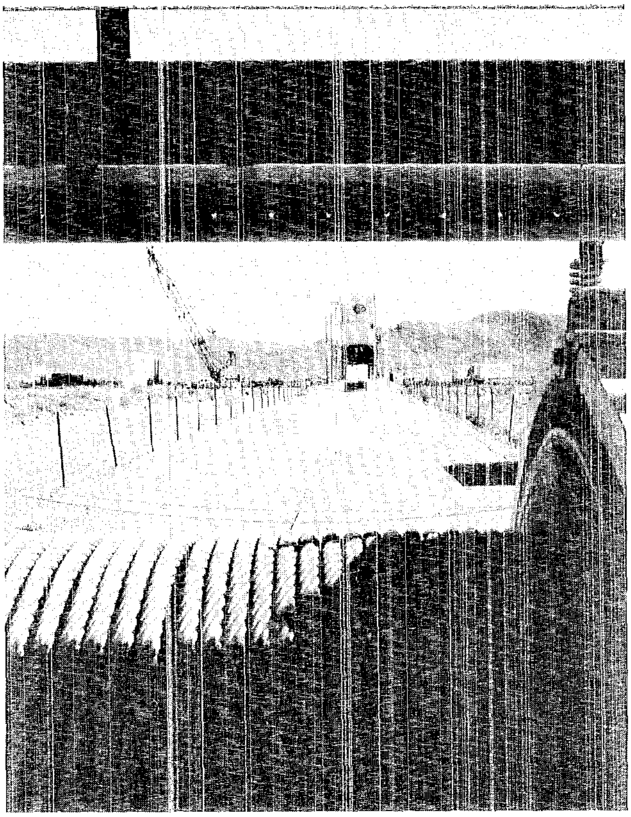
No one was injured in these tremors—nor in any of the more than 200 other such events which have shaken the desert floor and pockmarked the area with subsidence craters resembling the surface of the moon. In fact, many people within a few miles of the tremors' origin never felt a thing.

These tremors are attributable to this nation's underground nuclear explosive testing program conducted at the Atomic Energy Commission's Nevada Test Site. The Los Alamos Scientific Laboratory plays a major part in this program.

Although LASL is devoting much of its effort toward the peaceful applications of nuclear energy, its primary mission remains what it has always been—research and development work on nuclear and thermonuclear weapons and weapons components. And these weapons have to be tested.

Beginning with Operation Crossroads in 1946, the Laboratory conducted nuclear test operations in the Pacific. By 1951, the Laboratory also needed a "backyard workshop" where its scientists and engineers could test weapons with a minimum of time, travel and expense. Such a workshop was provided by the AEC by the creation of the Nevada Test Site near Las Vegas. Since that time, a number of continental test series, including more than 300 nuclear detonations, have been held in Nevada. This figure includes both atmospheric and underground tests.

To provide a testing site for LASL's nuclear weapons, satisfying all requirements of public safety, the Department of Defense, and later the AEC, prepared Bikini and Eniwetok Atolls in the Marshall Islands as a Pacific Proving Ground. Beginning in 1946, seven series of tests were conducted there. Another, based on Christmas Island and Johnston Atoll was held in 1962 before atmospheric testing was prohibited by the Limited Test Ban Treaty.



ABOVE: Huge winches are used to pull test sleds away from the test tower before cratering begins. These towers are used in physics shots. RIGHT: Hundreds of feet of piping is used in underground tests.

Before ratifying the Limited Test Ban Treaty, the U.S. Senate adopted four safeguards:

"A. The conduct of comprehensive, aggressive and continuing underground nuclear test programs designed to add to our knowledge and improve our weapons in all areas of significance to our military posture for the future.

B. The maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology which will attract, retain and insure the continued application of our human scientific resources to these programs on which continued progress in nuclear technology depends.

C. The maintenance of the facilities and resources necessary to institute promptly nuclear tests in the atmosphere should they be deemed essential to our national security or should the treaty or any of its terms be abrogated by the Soviet Union.

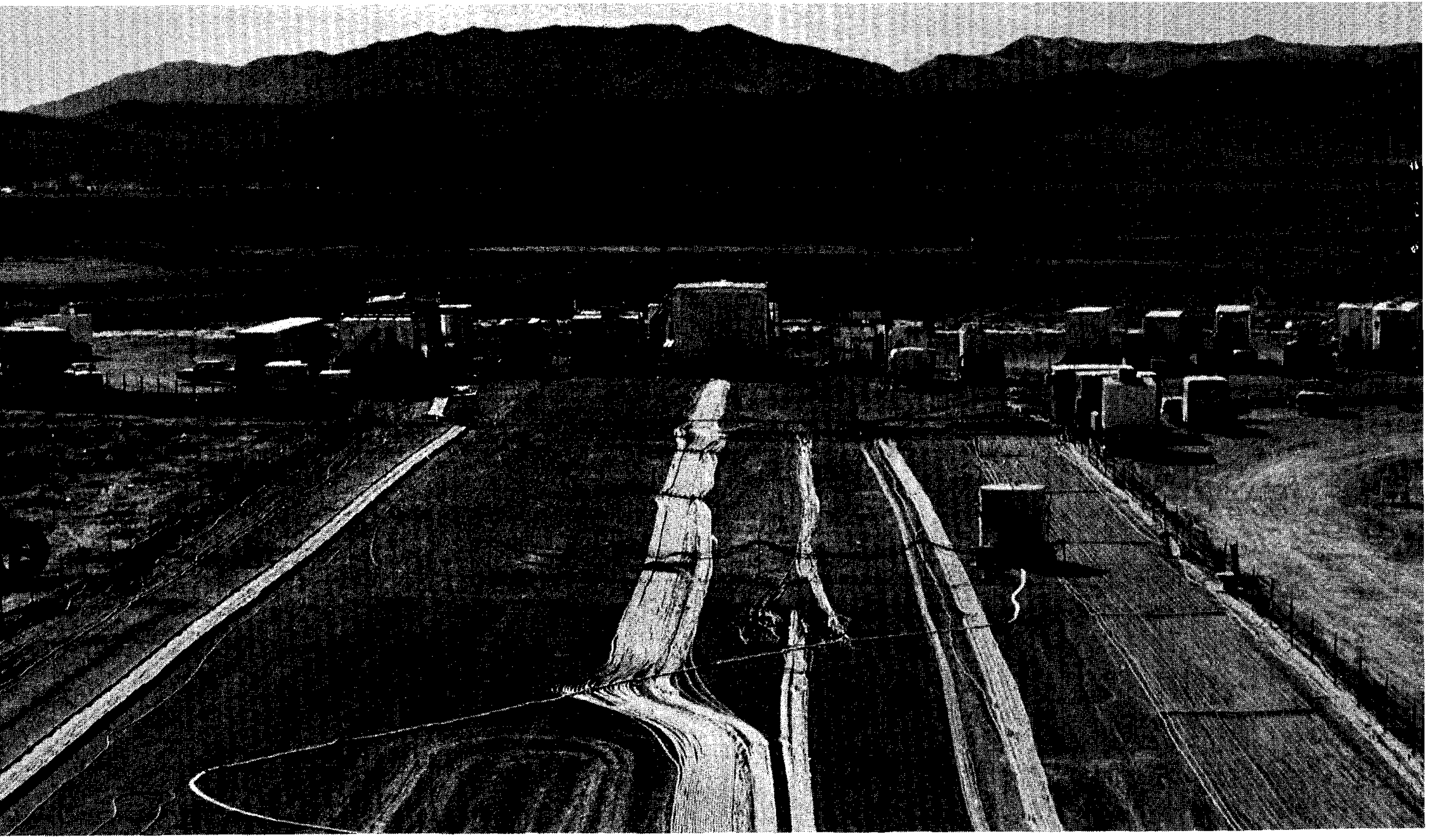
D. The improvement of our capability, within feasible and practical limits, to monitor the terms of the treaty, to detect violations and to maintain our knowledge of Sino-Soviet nuclear activity, capabilities and achievements."

The treaty was signed on Aug. 5, 1963, by the three principals—the U.S., the USSR and the United Kingdom.

Since the signing of the treaty, LASL has pursued a vigorous program in compliance with these safeguards. All nuclear test detonations have been conducted underground because the treaty forbids such detonations in the atmosphere.

It is extremely important to note that in addition to weapons data, a great deal of information relative to basic science has been and is being obtained by underground testing.

continued on next page



Underground Testing . . .

continued from preceding page

One of the more important by-products of this underground testing program has been the development of experimental methods to measure nuclear reaction probabilities (cross sections) for various elements, utilizing the high intensity, short duration burst of neutrons from an underground nuclear explosion.

With such an intense source of neutrons, measurements can be made which would not be possible using conventional neutron sources. A nuclear explosion produces more than a million billion times as many neutrons per unit time as an accelerator does, so experiments can be done which might take as long as 100 years if an accelerator were the neutron source.

Nuclear data collected from neutron physics experiments with nuclear explosives are of theoretical interest because the details of reaction probabilities cast some light on the actual structure of a nucleus. The same data are required for the development of any nuclear technology, including nuclear reactors, nuclear weapons and weapons diagnostic measurements.

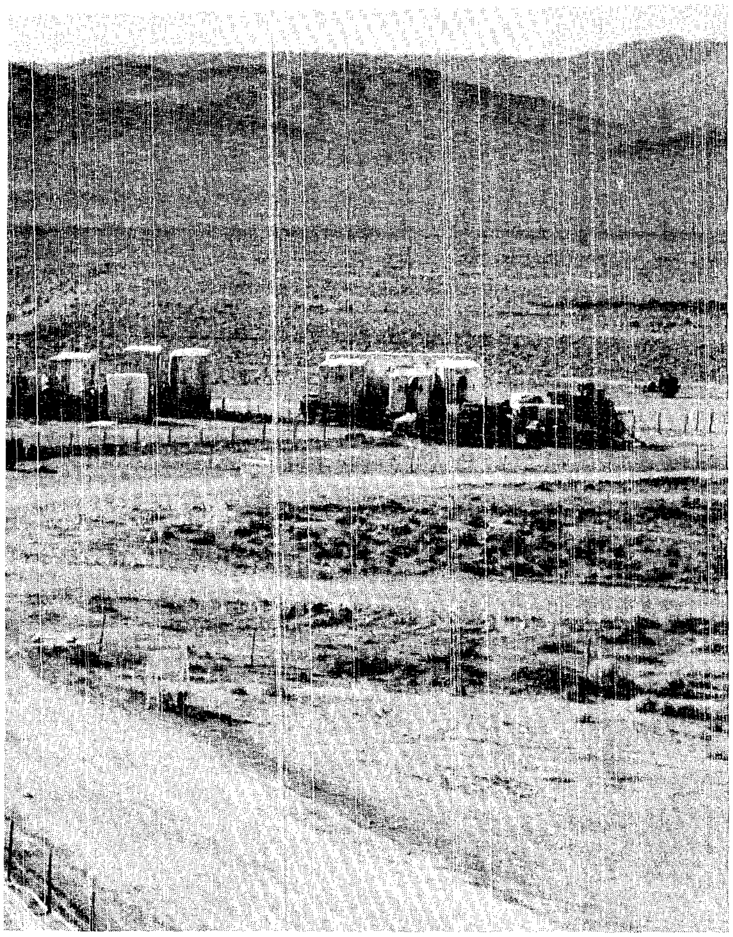
Of prime concern in any test is the safety of persons both on and off the test site. The AEC spends about eight million dollars a year to insure there is no danger to the health and safety of persons arising from an underground test of a nuclear device.

It should also be noted that considerable care is taken in the safety design of nuclear devices. The nuclear components of a weapon have never been accidentally detonated despite more than 20 years of storing, flying, overhauling, modifying, inspecting and otherwise working on and with nuclear devices.

The first completely-contained, deep underground shot was the Rainier event of the PLUMBBOB series on Sept. 19, 1957. This test of a 1.7 kiloton device at a depth of 790 feet was the first designed to contain the radioactivity underground and not allow any to escape into the atmosphere.

There had been a test in 1951, 17 feet underground and another in 1955 at 67 feet, but no attempt was made to contain the radioactivity. These early shots were to ascertain what the effects would be if a nuclear weapon were dropped from an aircraft and penetrated the ground before exploding.

continued on next page



Mobile diagnostic and control buildings, or "skid row," contain instruments required for basic measurements.

There was no testing from late 1958 to late 1961, during the test moratorium. However, on Sept. 1, 1961, the Soviet Union broke the moratorium, and within a few days the test site was back in business. The first underground shot of the present continuous program of the United States was fired on Sept. 15, 1961, and since August, 1962, all shots at NTS have been underground.

LASL technical divisions principally concerned with underground testing at NTS are J, W, GMX and H. Other divisions, such as P, have experiments associated with certain tests but are not connected with every shot. In addition, representatives of various service departments and groups including documentary photography, shops and others provide assistance as required.

Permanently assigned to the "weapons side" of the Nevada Test Site are members of groups J-3, J-6, J-7, J-8, H-8, SP-DO and J-DO.

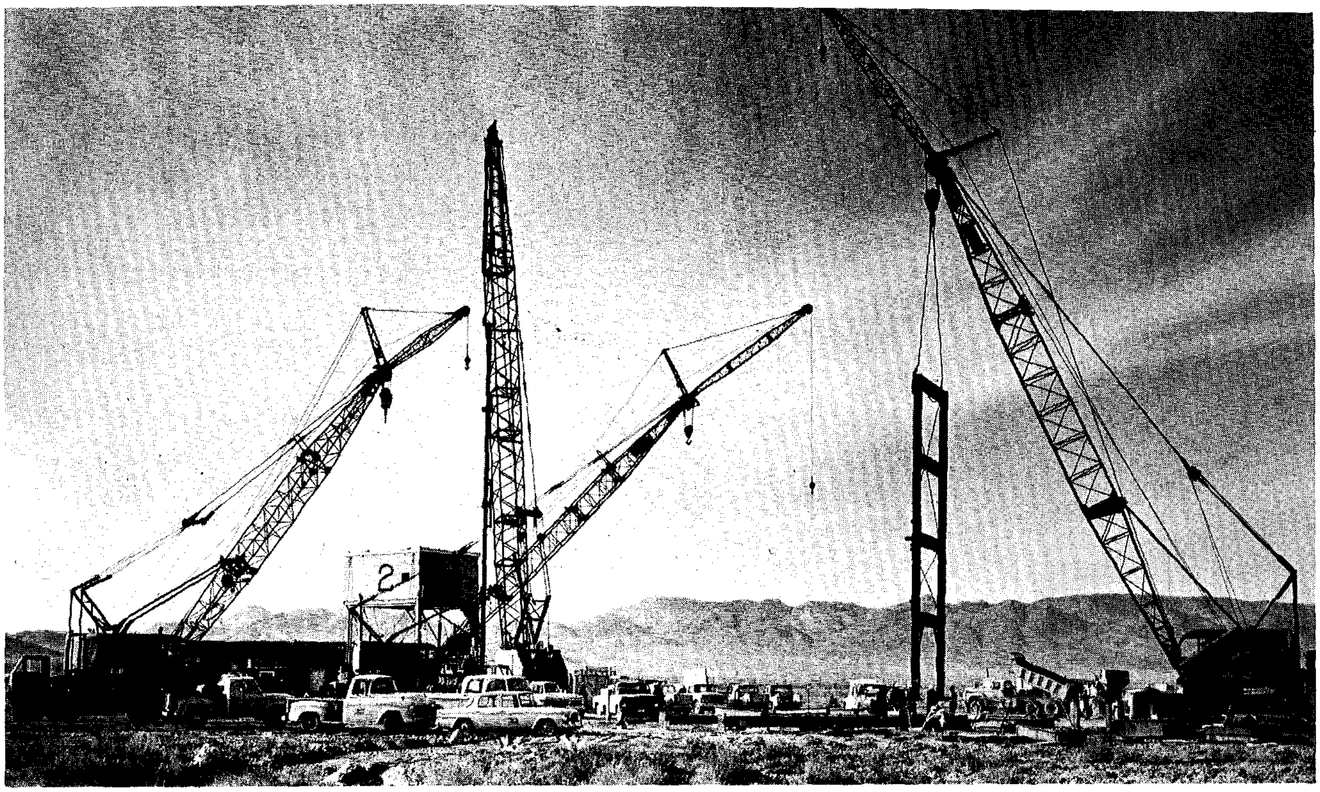
J-3 is responsible for providing operational, administrative and personnel support for weapons testing programs. J-3 arranges for vehicles, housing, communications, laboratory space and supervises employes on loan to the Laboratory from test support contractors. In brief, J-3 is the administrative support group.

J-6 is responsible for the construction and maintenance of field test facilities and provides the necessary field support of an engineering nature to the scientific groups. It coordinates the requirements of the test groups in the preparation of construction criteria, submits the criteria to the designated contractor through the AEC and provides technical inspection of the facilities under construction.

J-7 is an engineering group whose job is any work of a mechanical engineering nature done within the scope of the division's responsibility. The work consists primarily of mechanical design engineering in support of other J division groups participating in the weapons testing program. Most of the projects are of unusual engineering interest, involving design of special experimental test equipment.

J-8 is the electrical engineering group for the test division. It is the responsibility of this group to furnish electrical and electronics support to other groups. In maintaining a weapons test capability, J-8 is responsible for the timing and firing and signal

continued on next page



Construction activities at ground zero area involve a number of crafts and skills. LASL's J-6 is responsible for the construction of field test facilities in a LASL test.

Underground Testing . . .

continued from preceding page

sequence systems. Coordination of this timing and firing work with other organizations is also a responsibility of J-8.

H-8 is the field studies group of the health division. It provides personnel to oversee the Rad-Safe (Radiological Safety) program for LASL conducted by Reynolds Electrical & Engineering Co. (REECo). H-8 is responsible for documenting any release of radioactive effluent from underground test events. Personnel from the group serve as health physics advisors to the test group director.

SP-DO at the test site works very closely with J division in procuring and providing the necessary supplies and equipment required in the test program, as well as operating the LASL warehouse facilities.

J-DO is the overall chief of all LASL activities relating to underground testing. J Division Leader William E. Ogle has the ultimate responsibility within the test division for field tests of weapons and nuclear explosives. Robert Newman is test group director, with Tom Scolman as his alternate. Gordon Jacks of J-DO serves as full-time administrative chief at the CP-1 area—headquarters for test activities.

These, then, are the divisions and groups primarily concerned with most of LASL's underground nuclear testing activities.

But how is a test scheduled? Who digs the hole? Who pushes the button?

What follows is a brief summation of the steps taken in a normal test of a LASL nuclear device far underground at Yucca Flats, Nevada:

Tests are scheduled from a month to two years in the future. On an average shot, it takes about four months to get ready from the time the green light is given. This process has been done much faster when circumstances required it, and although this four-month period is the time needed for a normal test, the more complex shots naturally require a longer preparation time.

When the decision is made as to the device that will be used, a hole is selected. A small "hole inventory" is maintained, with holes being drilled in advance, in anticipation of the Laboratory's requirements. These and the other required cased holes are requested of the AEC's Nevada Operations Office in

Las Vegas which arranges the drilling contracts. Most holes are drilled by REECo. In an underground test, the hole is drilled to a depth calculated to contain the radioactivity and prevent venting. This depth will vary depending on numerous factors; it is often in the neighborhood of 1,000 feet.

In addition to the primary or "shot" hole, satellite holes—normally one to three—are sometimes drilled near the shot hole and contain instruments used to help obtain early estimates of the yield of an experimental device. More precise yield figures are derived from samples obtained by post-shot drilling.

Once the determination is made as to what experiments will be conducted, the necessary criteria are provided by the J division technical groups (J-10, J-11, J-12, J-14 and J-15) plus GMX, W, T and other divisions. Then working from this criteria, J-7 designs the necessary mechanical systems, J-6 the general construction systems and J-8 the electrical systems. These designs are submitted to the AEC which orders the work from one of its contractors.

The downhole hardware, including the diagnostic and device racks, are built in Los Alamos by Zia Company, as is the downhole structural cabling. Much of the other equipment to be used downhole is also constructed in Los Alamos by the LASL Shops Department and Zia.

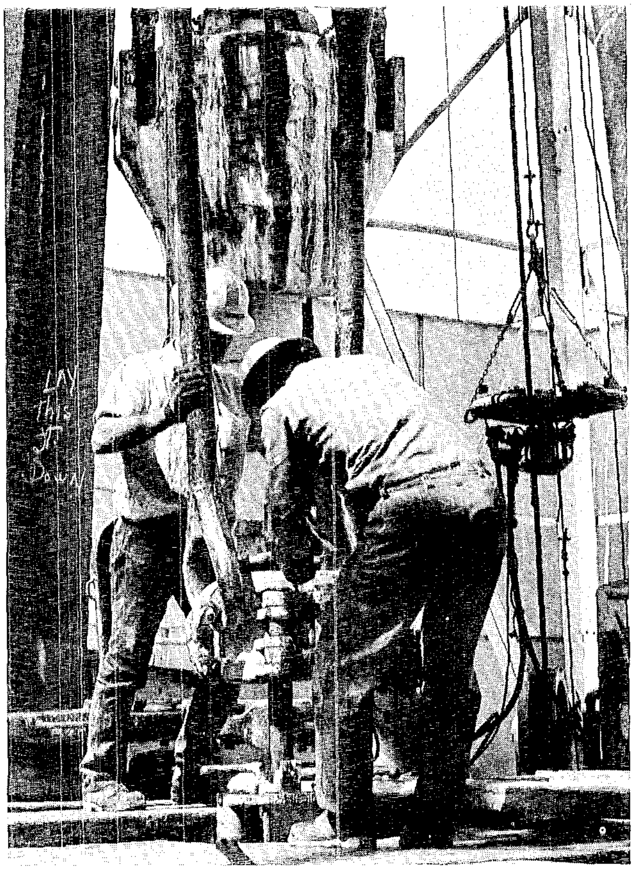
W and GMX divisions procure, assemble and provide the device and the necessary related parts. Normally, this device is not a complete weapon but may be in the experimental stage or may be a test of the LASL part of a weapon. The device is not taken to Nevada until just prior to emplacement in the shot hole.

After the criteria for a specific test are established, REECo. constructs the ground zero area—lays the electrical cables (perhaps as many as 100 or more), hooks up the power supply and moves in the portable buildings. LASL has a number of portable buildings at Nevada officially termed "mobile diagnostic and control" buildings but unofficially called "skid row." These structures house instruments required for basic measurements and are mounted on skids so they can be pulled over the desert for use in test after test. They contain a variety of complex instrumentation—in some cases up to 80 high-speed oscilloscopes. The buildings are shock-mounted to prevent damage to the buildings or their equipment. The arming and firing units are housed in a red-painted building, appropriately named "the red shack."

To assure that everything LASL requires is being done, J-6 closely follows all construction steps and arranges contractor support from beginning to end.

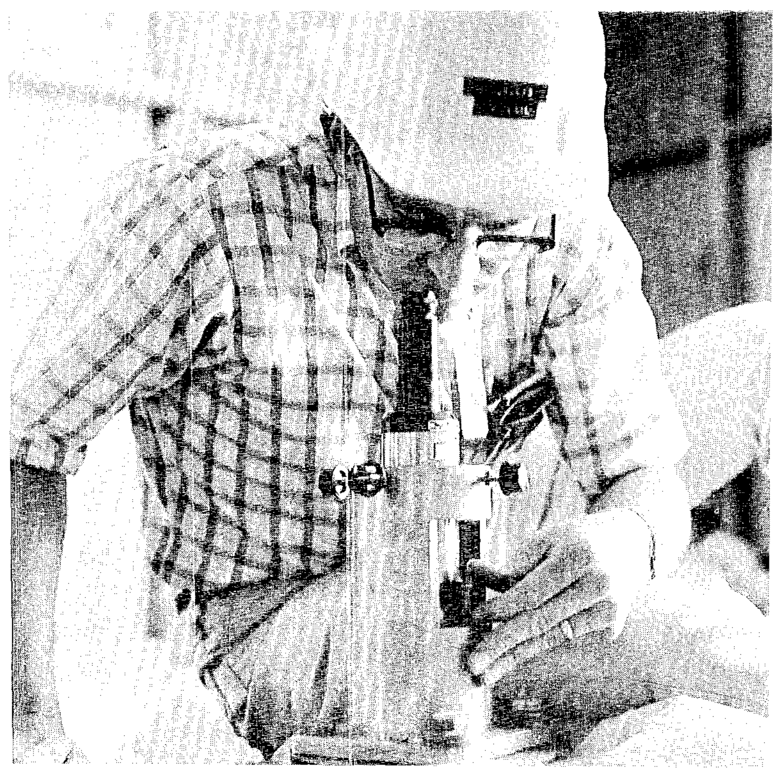
After the buildings are in place, EG&G, Inc., moves in to prepare the "skid row' for the forthcoming shot. J-14 furnishes instruction to EG&G on what diag-

continued on next page



Workmen prepare hole for underground shot. Since 1962, all U.S. weapons testing has been underground.

Al Ellis, P-3, checks downhole alignment of neutron beam pipe. A great deal of physics data has been obtained from underground shots.



Underground Testing . . .

continued from preceding page

nostic detectors will be needed and where they are to be located. J-14 also oversees the actual set-up of the recording equipment in the diagnostic buildings.

Dry runs—to provide a careful operational check of all control diagnostic and monitoring systems—are held before the actual shot. Normally 6 to 10 dry runs will be held, but sometimes many more are required.

When calibration tests and dry runs start, personnel from Los Alamos fly to the test site to augment the permanent staff. These include both technical and non-technical personnel from those groups normally concerned with a test, plus representatives from any other divisions or groups involved with a particular test or experiment. Between 20 and 100 people from "The Hill" may go to Nevada for a test.

The device is flown to NTS and stored in a special LASL storage area until time for emplacement. Storage is usually not longer than overnight. Sometimes the device is taken directly from the plane to the hole.

Before the rack containing the device is lowered downhole, a cylindrical mandrel of the same size or larger is lowered to make sure the device rack will not get stuck on the way down.

Days prior to a shot, the rack containing the device and downhole diagnostic equipment is lowered downhole. The diagnostic cables are taped together tightly at regular intervals to prevent rubbing together and possible damage. A metal Chinese finger-grip-type support is placed around the cables to hold their weight as they are lowered downhole.

After the device and diagnostic racks are lowered, the hole is backfilled with fine sand and pea gravel in alternating layers until the hole is completely filled. This backfilling is a slow and careful process to assure compaction and prevent air pockets from forming. After the backfilling, the "ground zero marker" is emplaced. This marker is a wooden post about 10 feet tall with a square wooden flag on top.

In order not to disrupt other work at the test site, shot time is normally set for early in the morning. However, unsuitable weather can cause postponement of a shot for hours, days or occasionally for weeks.

On the afternoon before a shot, a readiness briefing is held. The four primary topics considered at this briefing are readiness, weather, effluent and operations.

The test group director informs the AEC test manager of his group's readiness—whether the complex technical aspects are such that the test can proceed.

The weather forecast is studied, and its effect on any possible effluent release is predicted. There are fairly restrictive weather criteria for the protection of people on and off the site, and if there is any doubt, the test is postponed. The weather picture is studied—and recommendations are made whether to proceed with a test—on the afternoon before a test and again on the morning of a test. It is rare that any radioactivity is measured offsite, but each test is conducted as if the maximum credible accidental release of radioactivity were going to occur. For possible effluent documentation, radiation recorders are positioned close around the area of the test.

Also at the readiness briefing, a safety panel advises the test manager on all matters pertaining to health and safety of persons both on and off the test site. This includes the projected path of any possible effluent. This panel also determines the area surrounding ground zero which is to be evacuated by all test site personnel for the test.

The operations aspects considered at the readiness briefing include a determination of steps that will be taken if it is necessary to evacuate personnel outside the immediate area of the test.

About 6 to 12 hours before a test, the security forces begin their special pre-shot procedures. These include setting road blocks limiting acess to the area designated during the readiness briefing and "sweeping" the area by both vehicle and aircraft. This sweep checks every shack and shelter within the safety zone, places guards on all roads leading to the shot area and evacuates all personnel not on the approved access lists for the area.

Persons who have to remain in the area in the performance of their duties are badged with special muster badges which are accountable. The personnel remaining in the area make last minute checks and adjustments.

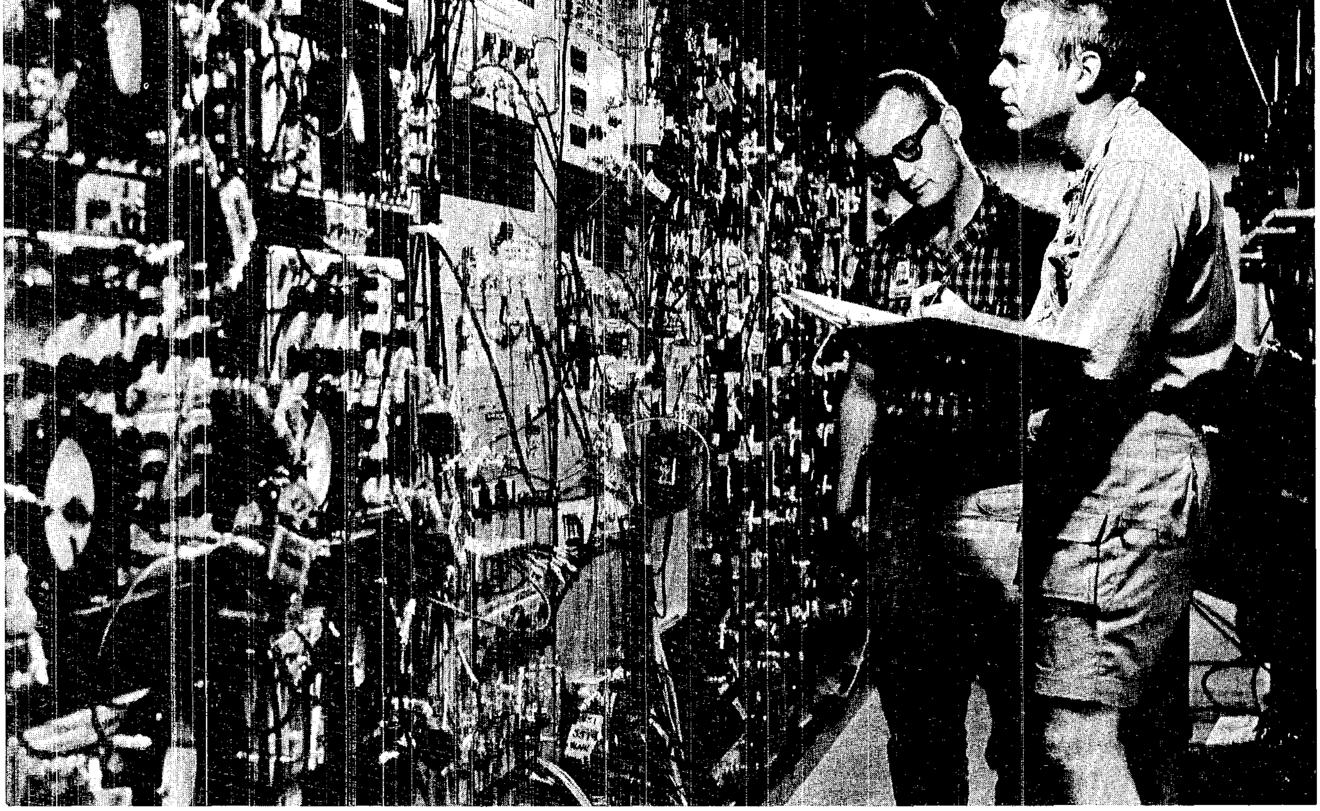
At about minus four hours another sweep is made which carries with it all but the arming party.

At this time, everything is buttoned up with one exception: the device itself is not armed. The cable connections to the device are not completed until the latest possible time.

After the device is armed, the arming party withdraws outside the safety area, leaving the area cleared of all personnel.

When everything is ready, the AEC test manager gives the OK to the test group director who in turn passes the word to proceed with the test.

Firing is by automatic count-down sequencer which will not function if certain diagnostic and measuring equipment is not functioning correctly. The sequence can be halted at any time, either automatically or manually, if a malfunction occurs. If the malfunction can be corrected from the Control Point, this is done and the sequence resumed; if it is necessary to re-enter the area for repairs, the device is first disarmed. Safety is always paramount, and chances are not taken.



"Skid row" buildings contain a variety of complex instrumentation required for basic measurements in an underground test.

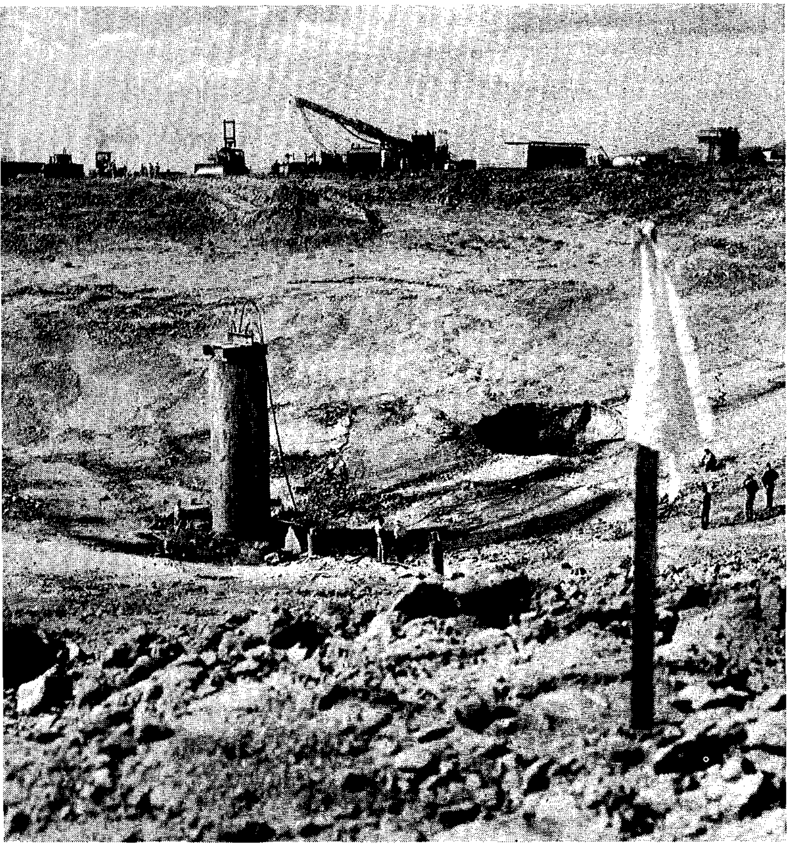
At shot time, personnel in the area crowd into the main Control Point building to watch the test on closed circuit television. The prompt visual evidence of the explosion deep underground occurs when the TV pictures shows the ground heave, followed by brief, violent motion of the picture as the ground shock reaches the close-in camera. Sometimes ground shock and roll are felt at the CP area—but not always.

Most underground nuclear explosions result in a subsidence crater at the surface. This cratering may occur any time from minutes to hours after the shot. As cratering occurs, the ground zero marker drops out of the picture, and a large cloud of dust appears.

One of the best descriptions of what occurs deep underground at the precise instant of an underground nuclear explosion is to be found in a book entitled "The Effects of Nuclear Weapons," edited by Dr. Samuel Glasstone, a LASL consultant. This account follows:

> "A deep underground explosion is one occurring at such a depth that there is little or no venting of the weapon debris through the surface of the ground. The following description is based on the observations associated with the RAINIER event of Operation PLUMBBOB in 1957, in which a 1.7-kiloton TNT equivalent nuclear device was detonated at a depth of 790 feet below the surface in a medium referred to geologically as 'tuff.' All of the radioactivity as well as the heat energy were contained in the ground. The phenomena can best be described in terms of four phases having markedly different time scales.
>
> "First, the energy of the nuclear explosion, which took place in a chamber 6 feet by 6 feet by 7 feet in dimension, was released in less than a one-millionth part of a second, i. e., less than 1 microsecond. As a result, the pressure in the chamber rose to several million atmospheres within a few seconds, and the temperature reached about a million degrees. In the second (hydrodynamic) stage, which was of a few hundredths of a second duration, the chamber expanded under the influence of the tremendous pressures to produce a spherical cavity 62 feet in radius. At this stage the cavity was lined with a shell of molten rock about four inches thick. The shock from the explosion crushed the rock to a radius of 130 feet and fractured it to 180 feet. The shock continued outward, its amplitude decreasing with increasing distance until it became attenuated. Seismic signals were detected out to distances of several hundred miles, and a weak signal was recorded in Alaska.
>
> "In the next phase, lasting for a period of seconds to minutes, the molten material flowed down the walls and collected at the bottom of the cavity. Here it froze to form a glassy mass which contained 65 to 80 per cent of the total radioactivity of the fission

continued on next page



Area around ground zero subsides after the shot, exposing a portion of the downhole shaft.

Underground Testing . . .

continued from preceding page

products; the remainder was distributed throughout the crushed zone. The third stage ended when the roof collapsed, thus enlarging the chamber upward for a distance of about 400 feet. The temperature then dropped as a result of expansion of the gases and the introduction of colder rock and other material. In the final (or long-term) stage, the heat gradually diffused outward and the radioactive material decayed in the usual manner.

"Records, obtained at stations located 110 to 350 miles from the test site, showed that the seismic signal of the RAINIER shot was equivalent to that from an earthquake of magnitude 4.06 on the conventional Gutenberg-Richter scale; this would be described as a 'minor' earthquake. Such a disturbance, originating from a movement of the earth's crust, should be perceptible to individuals as far as 60 miles from the epicenter. However, of the observers located two and a half miles from ground zero at the time of the RAINIER detonation, only a very few felt any ground motion."

Shortly after the crater forms, the test director requests the re-entry of the Rad-Safe monitor teams. If conditions warrant, re-entry of the data recovery teams is also authorized. Later, the entire area, except the crater, is opened to all personnel.

Soon after a shot, LASL scientists and technicians are concerned with post-shot drilling for debris samples used to determine radiochemical yield. For several years, all post-shot drilling was accomplished from within the crater with vertical drilling rigs. However, for the past few years LASL has used angle or directional drilling from outside the crater because it is easier and safer. In post-shot drilling, hole preparations are completed before a shot. The hole is partially drilled, cased and plugged. Then, soon after a shot, the drilling continues to the desired depth for sample recovery. The recovered samples are placed in lead pigs and flown back to LASL for radiochemical analysis by J-11.

And so, except for the radiochemistry, data analysis and paperwork, another underground nuclear test is completed. For most people, even those on the test site, the only outward manifestation is a routine news release which says tersely:

"A nuclear test of low yield was conducted underground today by the Atomic Energy Commission at its Nevada Test Site."

(Low yield is defined as less than 20 kilotons, low-intermediate yield is 20 to 200 kilotons, intermediate yield is 200 kilotons to 1 megaton.)

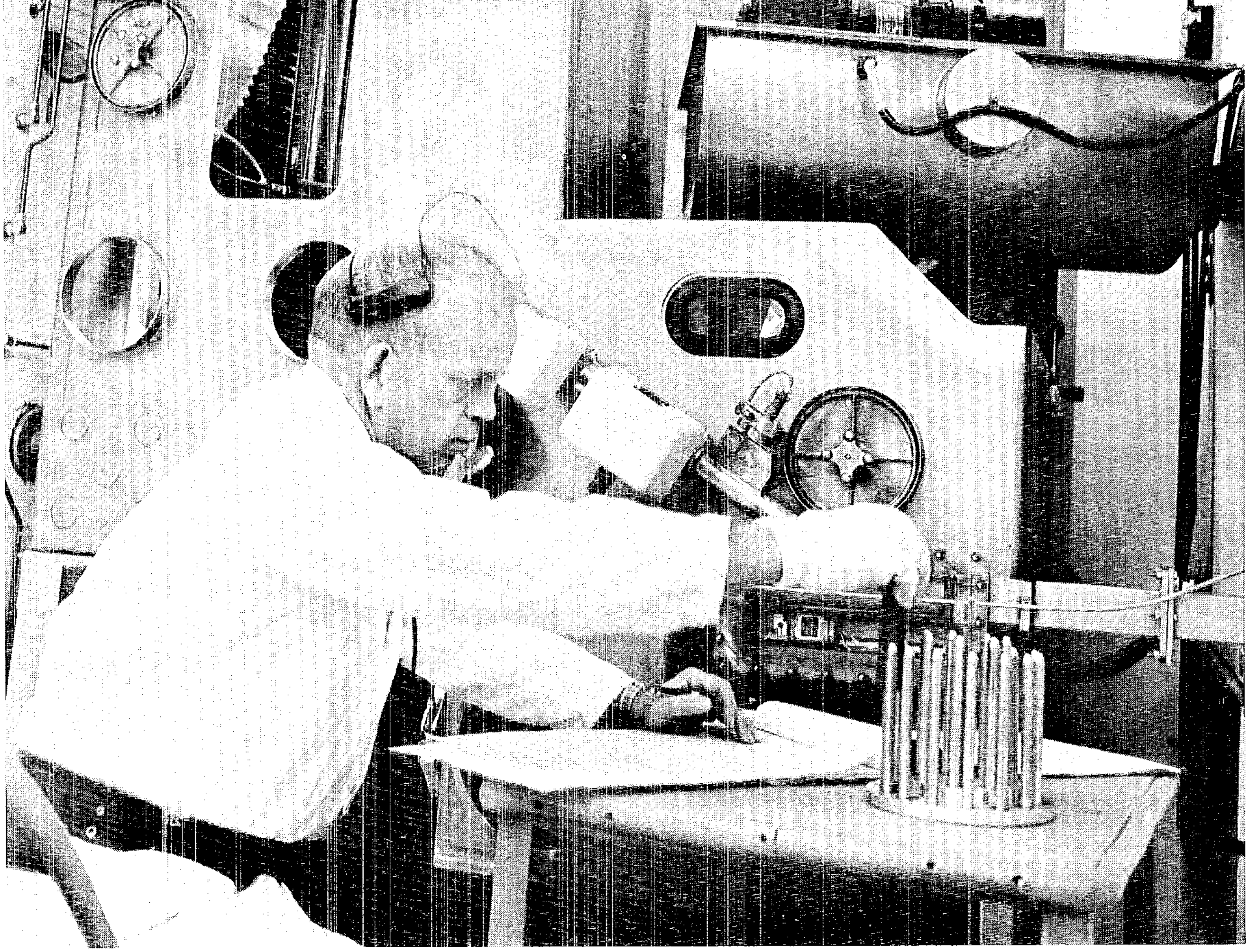
Although the Nevada Test Site encompasses about 1,350 square miles, it cannot all be used for underground testing. Much of it is committed to other programs, such as Project Rover; much of it is unsuitable from a geological standpoint; and much of it is too near permanent structures that could be affected by ground shock, or off-site inhabited areas which could be adversely affected by wind direction during a test.

The AEC is drilling in two other areas for possible future use as underground nuclear testing areas. These are in the isolated Hot Creek Valley in Central Nevada north of the present test site and Amchitka Island in the Aleutians off Alaska.

Purpose of the proposed supplemental sites is to test devices with greater explosive energy than those that can be tested safely at the existing test site. The AEC has announced that any use of these areas would not affect programs now conducted at NTS.

Improvements in the instrumentation and testing techniques have made it possible to gain much information, valuable both to science and the weapons program, from such underground testing operations.

More than 80 per cent of all fission and fusion weapons and warheads now in U.S. stockpile were developed at Los Alamos, which remains the nation's foremost center for nuclear weapons research and development.



Maynard Roberts checks fuel element before placing in loading tube. Specifications on each element were entered on fuel loading log sheet and read to control room operator for confirmation before loading.

UHTREX Goes Critical

By Bill Regan

A NEW RESEARCH TOOL was added to the Los Alamos Scientific Laboratory's power reactor division when UHTREX (Ultra High Temperature Reactor Experiment) reached criticality last month.

Experiments by group K-4 at a very low power level began almost immediately and will continue for a number of months. Before raising the power to the design level of three megawatts, it is necessary to determine basic characteristics of the new reactor.

Low power experiments which have been conducted to date include a cooperative effort with J-11 to measure the power profile in the

continued on next page

UHTREX . . .

continued from preceding page

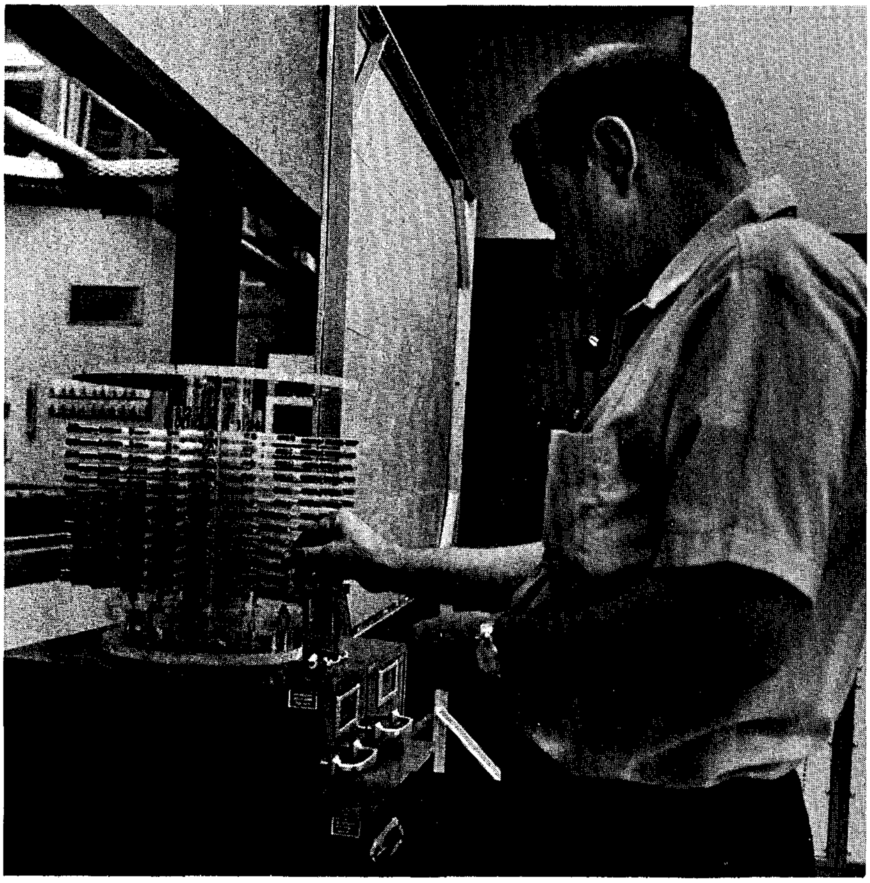
reactor core. Metal wires were placed in each of 52 fuel elements in one of the 24 core segments. After irradiation, the wires were removed and counted by J-11. The temperature coefficient of reactivity is also being determined by heating the system and noting the change in criticality with the rise in temperature. Because the temperature coefficient of UHTREX is negative, the reactor becomes subcritical as the temperature increases. Therefore, a fuel loading of nearly twice the present one will be required when it is operated at design power and with an outlet coolant temperature of 2400° F.

Full power experimentation with UHTREX, LASL's part of the U.S. Atomic Energy Commission's program for developing high temperature gas cooled reactors which use helium as the coolant and graphite as the neutron moderator, will benefit the commercial nuclear power industry, according to K Division Leader David B. Hall. It has long been recognized that there is a significant chance for reduction in power reactor costs with high temperature gas cooled reactors.

UHTREX will be used to study various fuel concepts, to investigate the behavior of graphite fuel elements at temperatures up to 2400°F and to assess the effectiveness of a method for continuous purification of the slightly radioactive gas coolant. John Russell, K-4 group leader, said UHTREX has tremendously versatile capabilities for testing various types of fuel elements. The fuel loading equipment in conjunction with a rotatable core allows new elements to be inserted at will while the reactor continues at full power.

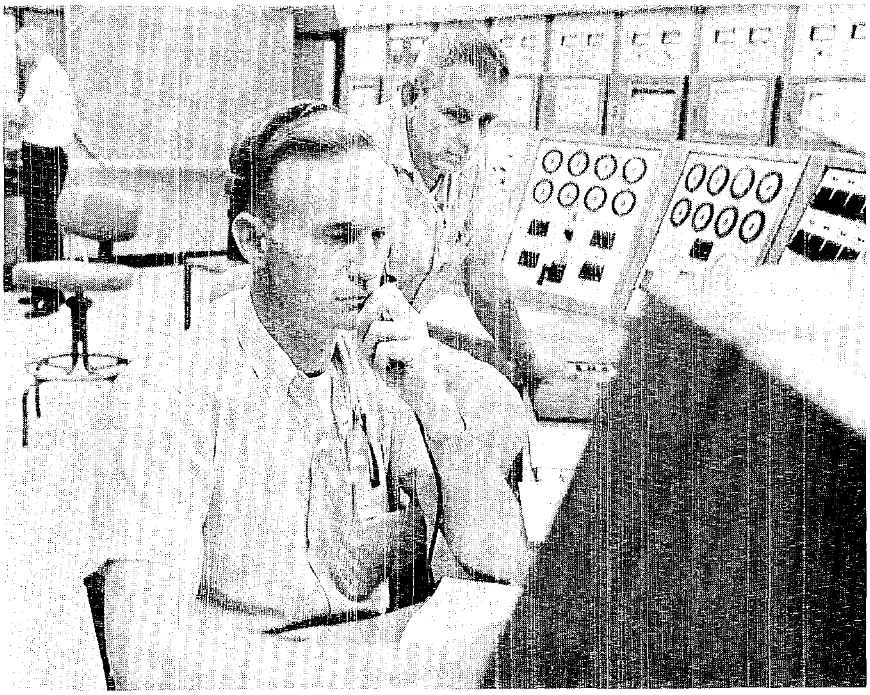
The layman may ask, "What's a UHTREX?" It is a gas cooled reactor. This is not new. The English built and placed gas cooled power reactors in commercial service as early as 1956. In the United States, a prototype of the newest

Fuel elements were laid out on table for checking and verification at the beginning of loading operations in July. From left: Patrick Dolin, K-4, Larry Brandt, summer student, K-4 Group Leader John Russell and Robert R. Martinez, K-4.



UHTREX Test Director Larry Booth uses three dimensional model of core to keep track of fuel elements loaded. Color coded pieces of pipe cleaner were inserted in model as each element was placed in the reactor core by remote control rams.

John Lundgren, left, Richard Johnson and Richard Daly, right, feed data into desk computer and anxiously wait for answers during night fuel loading shift.



John Kottmann, left, and Richard Johnson watch console which shows status of fuel element being loaded.

type gas cooled reactor built by General Atomics is on line producing power at Peach Bottom, Pa., and a much larger gas cooled reactor is scheduled for construction by General Atomics for the Public Service Company of Colorado at Fort St. Vrain, Colo. However, UHTREX is an ultra high temperature gas cooled reactor.

Ultra high temperature—this is the difference. The LASL reactor will operate at an outlet gas temperature of 2400°F. For comparison, the early English gas cooled reactors operate below 700°F, and the Peach Bottom installation goes up to only 1380°F. This dramatic increase in reactor temperatures is made possible by the substitution of refractory materials for the metallic fuel cladding previously used to prevent leakage of radioactive contamination into the cooling system. Greatest potential for ultra high temperature reactors appears to be in conjunction with gas turbines that can use the high temperatures effectively.

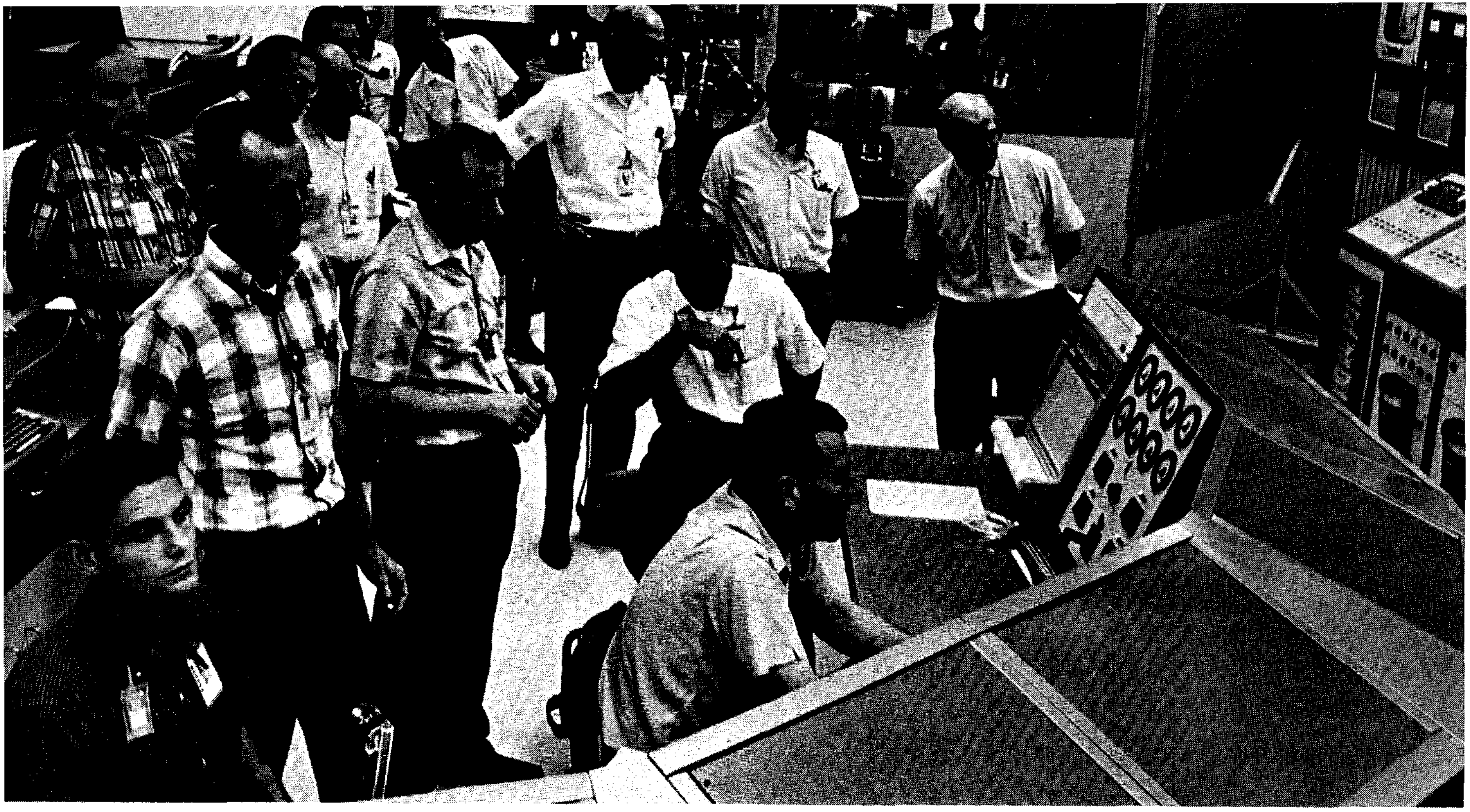
UHTREX will not generate electrical power. It will be used for experimental purposes only, contributing to the improvement of another generation of power reactors.

A unique mode of attaining criticality contributed to the suspense-filled last hours of the fuel loading operation which ended on the afternoon of Aug. 3. Normally, reactors are loaded with an excess of fuel over the calculated critical mass with the control rods in. Criticality is then reached by slowly withdrawing the rods.

In the case of UHTREX, however, criticality was attained by adding fuel in small quantities with the control rods out. Hall said this is probably the first time this method has been used anywhere for a reactor using individual fuel elements.

The reactor was initially loaded with its full complement of 1248 individual elements, which contained a mass of fuel slightly less

continued on next page



An intent group filled the control room and watched through window from hall outside as UHTREX reached criticality.

UHTREX . . .

continued from preceding page

than that required for criticality. Some of these were then replaced by new elements containing more uranium. Toward the end of the fueling process, a net gain of only about three grams of fuel per loading cycle was logged as elements containing 3.54 grams of ^{235}U were replaced by those with 6.66 grams. On Aug. 2, the data indicated that the critical mass would be 6.272 kilograms.

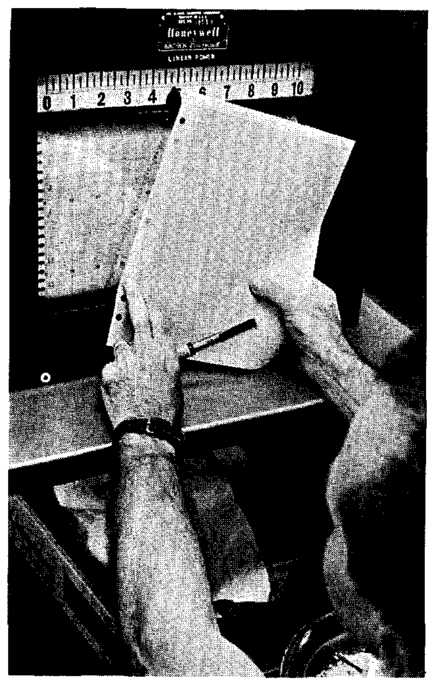
By the end of the second fuel loading shift at midnight Aug. 2, Larry Booth, K-4, test director, Byron "Mike" Carmichael, K-1, John Russell and Richard Daly, K-4, had estimated that 20 more elements loaded in a symmetrical geometry would be sufficient to attain criticality.

By early afternoon, Aug. 3, word had gotten around to almost everyone who had participated in the project that criticality was near. The control room group of active participants in the process of bringing the reactor to life was augmented by a nearly overflow crowd of visitors. Those in the hall pressed noses to the control room window as they read the latest data written on a blackboard. At 3:40 p.m. operator William Barney, manning the intercom to the fuel loading area, confirmed the loading of element number 127-428 by John Russell. This brought the core mass up to 6.276 kilograms.

A whole room full of intent eyes focused on the linear power recorder trace and saw what had been a vertical line start slanting away from zero. At the same time, the audible popper tone from the neutron counters changed from individual notes to a continous chatter.

This marked the end of seven years of design, development and construction—and the beginning of experimental operations. Cost of the UHTREX facility, including the reactor and related equipment, is estimated at seven million dollars.

An ever more slanting graph line on the linear power recorder marked the attainment of criticality by UHTREX.



Members of the Subcommittee on Communities of the Joint Committee on Atomic Energy met in Los Alamos last month to hear testimony on multi-family housing disposal in Los Alamos. At table in background are, from left, Sen. Wallace Bennett of Utah; Leonard Trosten, staff counsel for the Joint Committee; Rep. Thomas Morris of New Mexico, subcommittee chairman; and Rep. Craig Hosmer of California. Proposed legislation was discussed at hearing.

Committee Hears Housing Testimony

By Barbara Storms

The much-discussed problem of the sale of multi-family apartments in Los Alamos took still another turn last month when the Subcommittee on Communities of the Joint Committee on Atomic Energy questioned the advisability of selling the large apartment buildings to priority-holding occupants at all.

Rep. Craig Hosmer of California, a member of the JCAE and a former resident of Los Alamos, urged that the committee study the merits of offering the multi-unit efficiency, kitchenette and one-bedroom buildings to real estate investors qualified to operate large blocs of real estate and thus provide necessary rental housing on the Hill. The buildings referred to, all in the Eastern area, have 8 to 48 units per building and are being offered for sale in lots of one to seven buildings.

The suggestion came following the testimony of Fred Sclarge, an AEC security inspector and resident of a Kiva Street apartment, who reiterated his previous plea that rental housing be provided for newcomers, school teachers, single people, temporary residents and other such apartment dwellers.

Subcommittee Chairman Rep. Thomas Morris of New Mexico asked the local Atomic Energy Commission area office to provide the committee with facts and figures on present and projected rental supply and demand and the numbers and sizes of buildings involved to help the subcommittee in its considerations. If the big buildings are removed from the priority sale, appropriate provisions would have to be included in the legislation under consideration, Morris said.

The question arose during the public hearing held at the civic auditorium on Aug. 11 to consider proposed legislation that would amend Section 58 of the Atomic Energy Communities Act of 1955 to provide more flexibility in awarding priorities for the purchase of quadruplexes, octoplexes and other apartment buildings on the Hill. As it now stands, Section 58 authorizes the awarding of first priority to purchase only to legally-organized cooperatives composed of project-connected occupants of the buildings. HR 9199 and SB 1623,

continued on next page

Multi-Family Housing . . .

continued from preceding page

identical bills introduced last spring by Rep. Morris and Sen. Clinton Anderson, would make it possible for individuals or groups of occupants, not necessarily co-ops, to obtain priority to purchase.

Specifically, under the provisions of the amendment, each occupant of an apartment would be given a priority interest in the purchase of his building. The occupant could then assign his interest to another occupant or group of occupants. The occupant or entity who could demonstrate that he represented at least 70 per cent of the occupants of the building would be given first priority to buy. Second priority would go to an entity whose membership consists of at least one occupant plus project-connected people or Los Alamos residents who agree to occupy at least 70 per cent of the units in the building.

Any occupant who did not wish to participate in such a purchase would be entitled to a 15-month lease on his unit from the AEC.

The proposed legislation is based upon recommendations made by the Ad Hoc Committee on Disposal of Multi-Family Housing as a result of hearings held early this year after protests from apartment residents halted the sale of the buildings last October. Opposition was based primarily on the cooperative system which requires the purchase of at least five units, forcing quad residents to buy at least two buildings. Many objected to the requirement for professional management of the co-ops, and others felt the requirement that all occupants be project-connected discriminated against widows and retired persons who might wish to participate in the sale.

Franklin Parks, associate general counsel for the AEC, who chaired the Ad Hoc Committee, told the subcommittee hearing:

"We believe either bill, if enacted, will alleviate the diverse conditions which led to community dissatisfaction with the existing program. At the same time, we believe that the disposal program authorized by these bills will provide a more equitable basis for the sale."

Parks said the new procedure would present occupants of apartment sales lots with the maximum flexibility in determining how the sales lot would be purchased.

"For example," he said, "two or three occupants of a quad could assign their priority interest to one occupant, and he could purchase as an individual. Or, they could assign their priority interest to a corporation they formed or to a cooperative which was large, medium or small. They could even assign their priority interests to a corporation they formed which could, after purchase, take the necessary steps to convert the property to condominium ownership if that was the desire of the occupants and permissible under state law."

He added that with only 70 per cent of the occupants of an apartment sales lot required to effect a purchase on the first offering and only 70 per cent of the units in the second offering, it is possible that a substantial number of rental units will remain in the apartment properties so purchased.

Permitting those whose interests are not represented by the purchaser to obtain a 15-month lease, Parks said, should minimize the dislocation of present residents.

Most witnesses at the hearing backed up Parks' belief that the bills would be acceptable. Chuck Caldwell, a 14-B resident who started the protest movement last fall, said he was happy with the proposed legislation, although he would have preferred to see provisions made for the splitting of quads for individual ownership. Alan Rawcliffe and Barbara Hoak, speaking for Los Alamos Community Homes, Inc., frequently called "the big co-op", said they approve of the bills and would like to see legislation expedited.

Several witnesses pointed out the need for more specific definition of the term "resident," and the subcommittee agreed that considerable clarification would be required to insure against speculators who might move to the Hill for the sole purpose of acquiring property.

County Commissioner Martin Gursky urged the subcommittee to expedite action on the bills and reiterated his statement made to the Ad Hoc Committee in January that "if Los Alamos is truly to function as a self-governing community, the people of Los Alamos must feel a sense of belonging and participation in the community. This sense cannot exist when so many people are insecure in so basic a human need as shelter for themselves and their families."

In answer to questions from Rep. Morris, AEC Area Manager Herman Roser said if the legislation were enacted during the present session of Congress, the sale could begin about two months later. He said he thought it would take about two years for the sale to be completed, depending upon the number of buildings sold during the first priority offering. He said an intensive informational campaign—about six months for each priority offering—would be essential to make sure the public completely understood each aspect of the program. Roser said the most optimistic estimate would be about one year for completion of the sale.

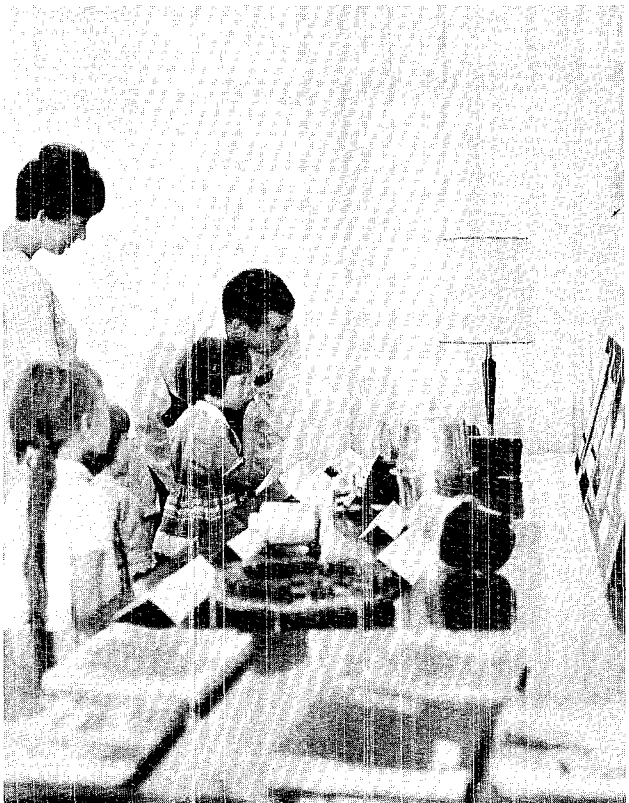
Roser assured Chairman Morris that his office would take every step necessary to implement the sale as quickly as possible when the legislation is enacted.

In addition to Representatives Morris and Hosmer, the Subcommittee on Communities, which conducted the hearing, included Senator Wallace Bennett of Utah.

Leon Heller, T-9, explains the periodic chart of elements to his family after they had watched movies on atomic energy during the open house.

Ralph Stevens, MP-4, right, shows a model of the proposed meson physics facility to visitor John Evans, of Oshkosh, Wisc., and their children.

Open house last month at the new Physics Analytical Center adjoining the physics building gave Los Alamos scientists an opportunity to show their families some of the work going on at LASL. John C. Hopkins, P-DOR, shows his wife and children some exhibits explaining part of the Vela program.



Families Visit New Physics Analytical Center

new hires

CMB Division

Jimmie E. Troxel, Denver, Colo., CMB-1
Craig S. Smith, Albuquerque, CMB-8
James S. Boothe, Portales, N. M., CMB-8
Maurice W. McCloskey, Jr., Los Alamos, CMB-14

D Division

Matilda E. Sanchez, Los Alamos, D-2

Engineering Department

William R. Foley, Albuquerque, ENG-2
Gary A. Borkman, Glendale, Calif., ENG-3
Eugene D. Sandoval, Santa Fe, ENG-3
Bobby Joe Donham, Las Cruces, N. M., ENG-6

GMX Division

Richard J. Hassman, San Francisco, Calif., GMX-4

H Division

Allen M. Valentine, Las Vegas, Nev., H-1

J Division

Donald G. Roberts, Albuquerque, J-7
Perry R. McNeill, Stillwater, Okla., J-8
Henry G. Horak, Lawrence, Kans., J-10
Qualia S. Nasise, San Juan Bautista, Calif., J-11

MP Division

Arvid S. Lundy, New York, N. Y., MP-1 (AE)
Jerry D. Wallace, Minneapolis, Minn., MP-AE
Nancy A. Romero, Santa Fe, MP-2
Richard T. Tregellas, Albuquerque, MP-AE

Mail and Records

Cheryl A. Barton, Great Lakes, Ill., M&R

P Division

Judith A. Elder, New Orleans, La., P-DOR
Thomas J. Humphrey, Los Alamos, P-16
Clair W. Nielson, Swarthmore, Pa., P-18

N Division

Joe E. Griego, Santa Fe, N-4

Personnel Department

Lorna C. Scargall, Los Alamos, PER-7

Shops Department

Thomas J. A. Novak, East Alton, Ill., SD-1
James N. Long, Sullivan, Mo., SD-1
Doyle L. Wallace, Twin Falls, Idaho, SD-1
Donald G. Weaver, Salem, Ohio, SD-1
Juan F. Martinez, Jr., Albuquerque, SD-2
David S. Griego, Albuquerque, SD-2

Supply and Property

Delores A. Morrow, Los Alamos, SP-DO
Ronald D. Clayton, Los Alamos, SP-3
Jerald L. Johnson, Alamosa, Colo., SP-3
Dolores R. Roybal, Santa Fe., SP-12

T Division

Lani R. Schuster, Los Alamos, T-1
Joan H. Hundhausen, Los Alamos, T-1

Three Long-Time LASL Employes Retire

Three Los Alamos Scientific Laboratory employes retired recently.

Leona M. Kelly, CMB-1 group secretary, retired July 21. She had been with LASL since November, 1954, working first in group H-1 and later in CMR-1. Her husband is Leo Kelly, an employe of SD-1. They have two sons, Leo Michael, who works in MP-3, and Maxie, a student at the University of New Mexico.

Charlotte (Johnny) Johnson, an electronics assembler, retired Aug. 31. She and her late husband, Jerome, who was an employe of the Shops Department until his death several years ago, came to Los Alamos in 1943 from Wisconsin. She recalls their having lived in the "Big House" for several months until other housing was available. Mrs. Johnson went to work for group P-1 in December, 1943, and has been with that group continually since. Although retiring from her LASL job, she plans to keep busy with her many activities, including bridge and garden clubs, in Los Alamos. She has a daughter, Mrs. Joseph E. Marx, who lives in White Rock.

James W. Noble, SD-1 metalsmith, retired Aug. 11. He joined LASL 22 years ago, on Aug. 10, 1945. A native of Washington state, he had made his home in Seattle, where he was plant superintendent at Solvents, Inc., and at McNeil Island, where he worked as superintendent of shops for the Justice Department at the Washington State Vocational Training School. He and his wife, Ethel, plan to remain in Los Alamos.

ATOM Wins Top Award

For the fourth consecutive year, The ATOM has been awarded first place in the annual evaluation and awards program sponsored by the Association of Nuclear Editors. Commented one of the judges: "The quality of your writers and photographers cannot be denied—excellent. Second place went to the Sandia Lab News. The ATOM, the official magazine of the Los Alamos Scientific Laboratory, is now in its fourth year of publication.

The June, 1967, issue of The Atom incorrectly identified Mr. John W. Conant as being an employe of the Westinghouse Astronuclear Laboratories, when he is in fact employed by Aerojet-General Corp. While every effort is made by The Atom to be completely accurate, once in a while it is given incorrect information. We would like to take this opportunity to apologize to Mr. Conant and to set the record straight. Mr. John W. Conant, currently working with group N-1, is a staff member of the Aerojet-General Corp.

The Technical Side

Panel Discussion, National Classification Management Society, Third Annual Seminar, Washington, D. C., July 19-21:

"Classification Management Among Non-Profits" by L. M. Redman, D-6.

Gordon Research Conference on Corrosion, New London, N. H., July 24-28:

"Some Brief Comments on the Leed Studies of UO_2" by W. P. Ellis, CMB-8.

Presentation at Advanced Study Institute, Earth's Particles and Fields, sponsored by NATO and the Max Planck Institute für Physik and Astrophysik, Stadt Freising, Germany, July 31-Aug. 11:

"Solar Wind Observations" by J. H. Coon, P-4 (Invited Talk).

"Characteristics of the Plasma Sheet in the Earth's Magnetotail" by S. J. Bame, P-4 (Invited Talk).

"The Electric Fields and Plasma Convection in the Magnetosphere" by E. W. Hones, P-4 (Invited Talk)

Presentation at American Society for Engineering Education—National Aeronautics and Space Administration Summer Faculty Institute, Langley Research Center of NASA, Newport News, Va., Aug. 1:

"Numerical Hydrodynamic Studies at Los Alamos" by B. J. Daly, T-3.

Presentation at New Mexico Mine Operators Safety Council, Grants, N. M., Aug. 4:

"Respirator Program for Uranium Mines" by E. C. Hyatt, H-5. (Invited Talk).

Presentation at Sandia Corporation, Albuquerque, Aug. 11:

"The Geodesic Completion of Einstein Manifolds" by R. D. Richtmyer, T-DO consultant.

Fourth Research Reserve Seminar in Applied Research (Naval Reserve), Sandia Base, Albuquerque, Aug. 15:

"Materials Development at the LASL" by J. M. Taub, CMB-6. (classified talk)

"Radiochemical Research" by G. A. Cowan, J-11.

"Medium Energy Physics Research and the LAMPF" by Louis Rosen, MP-DO.

Ninth Annual Explosives Safety Seminar, Armed Services Explosives Safety Board, San Diego, Calif., Aug. 15-17:

"Safety Problems with Abandoned Explosives Facilities" by W. C. Courtright, H-3.

Presentation at Course on Computer Aided Design, University of Missouri, Columbia, Mo., Aug. 16-17:

"Computational Methods in the NET-1 Network Analysis Program" by A. F. Malmberg, T-7.

Presentation at American Crystallographic Association Meeting, Minneapolis, Minn., Aug. 20-25:

"The Crystal Structure of $(NH_4)_2CeF_6$" by R. R. Ryan and F. H. Kruse, both CMF-4.

Presentation at Nuclear Physics Research Unit, University of Witwatersrand, Johannesburg, South Africa, Aug. 21:

"Time-of-Flight Measurements with Nuclear Detonation Sources" by J. H. McNally, W-8.

Cryogenic Engineering Conference, Palo Alto, Calif., Aug. 21-23:

"Hydrogen Heat Transfer in the Presence of Thermal-Acoustic Oscillations" by R. S. Thurston, CMF-9.

"Cryogenic Tests on a Teflon-Tube Heat Exchanger" by R. S. Thurston, K. D. Williamson, Jr., and J. C. Bronson, all CMF-9.

"Oscillations in Flowing and Heated Subcritical Hydrogen" by J. D. Rogers, Jr., CMF-9.

Association for Computing Machinery Symposium on Interactive Systems, Washington, D. C., Aug. 26-28:

"Utilization of 'Two-Dimensional' Compiler Input at LASL" by G. L. Carter and Chester Kazek, Jr., both T-1.

"The Maniac II System" by R. B. Lazarus, M. B. Wells, and J. K. Wooten, all T-7.

Third International Conference on Nuclidic Masses, International Union for Pure and Applied Physics, Winnepeg, Manitoba, Canada, Aug. 27-Sept. 1:

"A Model-Based Mass Law, and the r-Process as a Mass Law Test" by P. A. Seeger, W-8.

Eighth International Conference on Phenomena in Ionized Gases, Vienna, Austria, Aug. 27-Sept. 2:

"Diagnostic Methods Using Holography" by F. C. Jahoda, P-15.

Presentation at 25th Annual Meeting of Electron Microscopy Society of America, Chicago, Ill., Aug. 29-Sept. 1:

"A Replica Technique for the Inside Surfaces of Small Diameter Pipes and Tubes" by T. G. Gregory, Jr., GMX-1.

"Atomic Injection as a Contrasting Technique" by J. H. Manley, Dir. Off.

Presentation at the 12th International Congress of Refrigeration of the International Institute of Refrigeration, Madrid, Spain, Aug. 30-Sept. 6:

"On the λ-Anomaly in Hydrogen and Deuterium" by A. F. Schuch, R. L. Mills and D. A. Depatie, all CMF-9.

"Safety Problems and Safety Codes Concerning Liquid Hydrogen and Liquid Helium" by F. J. Edeskuty, CMF-9.

20

years ago in los alamos

Culled from the files of Los Alamos Times, September, 1947, by Robert Y. Porton

Lab Opens to Students

The University of New Mexico and the Atomic Energy Commission today announced a cooperative agreement which will allow the physics department at the university to offer an expanded program of graduate instruction leading to the degree of Doctor of Philosophy with a similar program to be inaugurated by the chemistry department in 1948-49. Expansion of graduate instruction in these fields has been made possible by cooperation of the university and the Los Alamos Scientific Laboratory.

This plan is the result of proposals made a year ago by the Laboratory at a conference at Los Alamos attended by representatives of several western universities, including representatives from the University of New Mexico. At that time the Laboratory offered to cooperate with these universities in the advanced training of graduate students in physics and chemistry by making its research facilities available under specified conditions.

Bazooka Explosion Victim Suffers Severe Injuries

Leroy Chavez, 12, was critically injured Saturday when a supposedly dud bazooka rocket projectile exploded. He was reported resting "comfortably" after showing considerable improvement during the past week. Contrary to rumor, both of the boy's legs were saved. In addition to a compound fracture of the leg, he received serious abdominal wounds and many shrapnel wounds.

Also injured was Donald Lewis Marchi, 5, who suffered ankle and head wounds, but was released after treatment.

The "dud" was apparently found on the Hill's rifle range about a year ago. The blast from the shell blew a hole about 16 inches deep and four inches wide in the ground. Shrapnel broke windows in nearby apartments, narrowly missing occupants, and tore holes in a new car parked approximately 20 feet away.

Operations Slates Round-up

"Yip-yip-yip!"—the call of the range-rider pushing the "critters" on to a new pasture—will echo on the project Saturday, Sept. 27, when the AEC plans a round-up of all stray cattle on the reservation. Acting to curb violations of the privacy of the site by ranchers in allowing their stock to graze here, the Operations Division said this week it will enlist the aid of horsemen of the locality in rounding up the cattle and driving them outside the boundaries of the project.

what's doing

LITTLE THEATER: *First production of the season,* "A Thousand Clowns," by Herb Gardener, Friday and Saturday, Sept. 15 and 16, 8:15 p.m., Los Alamos Civic Auditorium. Season tickets ($6) and single admission ($2) available at the box office of the auditorium. Season tickets also available from Kay Anderson, 2-3510. For reservations on season tickets, call Doris Schonfeld, 672-3464.

FILM SOCIETY: Civic Auditorium, admission by single ticket, 90 cents, or season ticket, $4.

Wednesday, Sept. 20, 7 and 9 p.m., "Casablanca"

OUTDOOR ASSOCIATION: No charge; open to the public. Contact leader for information about specific hikes.

Saturday, Sept. 16, Midnight country near Cabresto Canyon, Dibbon Hagar, leader, 2-6209.

Saturday and Sunday, Sept. 30-Oct. 1, Truchas Lake to Santa Barbara, Ken Ewing, leader, 8-4488.

PUBLIC SWIMMING: Los Alamos High School pool. Adults, 50 cents; students 25 cents.

Monday through Thursday, 7:30 to 9:30 p.m.

Saturday and Sunday, 1 to 6 p.m.

Sunday, 7 to 9 p.m. Adults only.

LOS ALAMOS CHORAL SOCIETY: Every Monday evening at 7:30 p.m. beginning Sept. 11, Pueblo Junior High School band room. *All interested new singers invited* to beginning rehearsals.

MESA PUBLIC LIBRARY EXHIBIT:

Aug. 29-Sept. 29: Posters Popular with West Coast College Students.

Rabi . . .

continued from page 1

"There never was an arms race in history that I know of which didn't end in war. To me, the very idea of deterrent doesn't make much sense because people who start wars are not 'all there' as far as rationality is concerned — and deterrent depends too much on rationality.

"There is a complementary relation between peace and security. If you carry the idea of security far enough, you can never have peace, because your security is founded on suspicion . . . Of course, if you go to the extreme in the other direction, then you're wide open to anybody. What we must find nationally is a rational balance between the desire for security and the desire for peace."

Roscoe Divine, one of 10 young athletes who have been training in Los Alamos this summer, crosses finish line to win the mile event at the High Altitude Track Meet in Los Alamos last month. Although his time at this meet was slightly over four minutes, the University of Oregon student has run the mile in 3:57. The athletes in training on the Hill have been sponsored by the U.S. Olympic Committee and by the Los Alamos Country Olympic Committee. The team that will represent the U.S. at the Olympic Games in Mexico City Oct. 12 to 26, 1968, will be selected next fall, but Olympic hopefuls began training at high altitude this summer. Los Alamos is one of the cities selected for training, since it is comparable to Mexico City's 7216-foot altitude.

BACK COVER:

Those rumbling noises heard in Los Alamos recently are not created by any Laboratory experiments--they are sonic booms from high-flying airplanes. Given the assignment of picturing this fact, PUB photographer Bill Jack Rodgers photographed Steve Johnston--who wondered why he was asked to look up at an empty blue sky--and then put his inventiveness to work in the darkroom. In his file of photos-that-might-be-useful-some-day, Rodgers found a picture of one of the Air Force Thunderbirds acrobatic team--flying upsidedown near the Nevada Test Site--and superimposed it over the photo of Johnston, who had been innocently watching the dismantling of the old Los Alamos courthouse on Trinity Drive.

Henry T. Motz
3187 Woodland
Los Alamos, New Mexico 87544